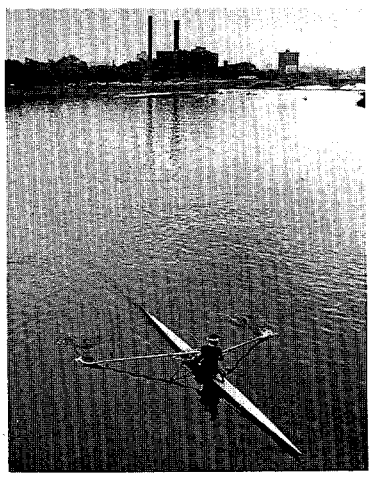
Report of the Southeastern New England Study



a Strategy for Balanced Development and Protection of Water and Related Land Resources in Eastern Massachusetts and Rhode Island

3. SOUTH SHORE PLANNING AREA REPORT

New England River Basins Commission

The Southeastern New England Study (SENE) is a "level B water and related land resources study." It was conducted under the provisions of the federal Water Resources Planning Act of 1965. The resources management program the Study produced was developed by a team of federal, state, and regional officials, local citizens, and the scientific community, under the overall coordination of the New England River Basins Commission. It is a part of the Commission's comprehensive, coordinated joint plan for the water and related land resources of New England.

The recommended program for managing the resources of Southeastern New England is described, in increasing level of detail, in the following Final Reports:

A SUMMARY highlighting the principal findings and recommendations of the Study, and their implications for the future of the region.

A REGIONAL REPORT and Environmental Impact Statement describing *in detail* the natural resources, issues and problems facing the region, the alternative solutions examined during the Study, the recommendations made, and their implications. It includes policies and programs for dealing with water supply, land use, water quality, outdoor recreation, marine resources, flood and erosion protection, and key facilities siting, and the changes in state and local government required to implement the program.

Ten PLANNING AREA REPORTS dealing with the same subjects as the Regional Report, but aimed at the local level. Eastern Massachusetts and Rhode Island were divided into ten "planning areas" based either on traditional sub-state divisions or principal river basins. Reports were prepared for the following areas:

1. **Ipswich-North Shore,**
2. **Boston Metropolitan,**
3. **South Shore,**
4. **Cape Cod and the Islands,**
5. **Buzzards Bay,**
6. **Taunton,**
7. **Blackstone and Vicinity,**
8. **Pawtuxet,**
9. **Narragansett Bay and Block Island,**
10. **Pawcatuck**

Other reports prepared during the course of the Study include the following:

Inventory Reports

For each of the ten planning areas, inventory reports were prepared covering the following subjects: climate, meteorology, hydrology, geology; land use, patterns, allocations, and management; special environmental factors; water supply; ground water management; water quality control; outdoor recreation; fish and wildlife; navigation; flood plain zoning and streamflow management; inland wetlands management; coastal resources; irrigation and drainage; sediment and erosion; power; minerals.

Special Reports

In addition to inventory reports, over a dozen special reports were prepared, including: Socio-Economic and Environmental Base Study, Volumes I and II; Economic analyses of water supply and demand issues, power plant siting, coastal resources allocation, and sand and gravel mining; Legal and institutional analyses of the state wetlands laws, arrangements for water supply service, fiscal policy and land control, access to natural resources areas, and management structure for water and land use issues; Urban Waters Special Study; Summaries of public workshops

Copies of reports are available from:

New England River Basins Commission
55 Court Street
Boston, Massachusetts 02108

National Technical Information Service
Springfield, Virginia 22151

and also in each of the 208 libraries and 210 town halls throughout the SENE region.

Report of the Southeastern New England Study

a Strategy for Balanced Development and Protection of Water and Related Land Resources in Eastern Massachusetts and Rhode Island

3. SOUTH SHORE PLANNING AREA REPORT

New England River Basins Commission
December 1975

SUMMARY REGIONAL REPORT
(with Environmental Statement) and
10 PLANNING AREA REPORTS

REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY

READER'S GUIDE: HOW TO REVIEW THIS REPORT

- In five minutes

  FOR A "THUMBNAIL SKETCH"

  Read the **OVERVIEW** which folds out as one large sheet. There is an extra copy in the pocket in the rear for those who would like to mount it on the wall.

- In a half hour or less

  TO LEARN THE MAIN POINTS

  Read the **SUMMARY**. It is published separately. You can read it in either of two ways:

  - **SELECTIVELY.** Read the Chapters on Goals and Approach and Guiding Growth, plus any others that interest you. Chapters are boldly labeled to facilitate selective reading; or

  - **ENTIRELY.** Read the full summary for a fuller understanding of the highlights of the SENE Study.

- In one day or less

  TO UNDERSTAND THE DETAILS

  Read the **REGIONAL REPORT.**

  - **SELECTIVELY.** It is organized exactly like the summary. Wherever your interests lie, you can turn to those sections for additional background, amplifications, analysis of rejected alternatives, and especially for the full text of each recommendation, including who should do what and when. Also, remove the Development Capabilities Maps in the rear pocket and examine the legend to appreciate the type of information the maps portray; or

  - **ENTIRELY.** Read the full report for full appreciation of all recommendations, and how they interrelate.

- In an additional 10 minutes to 2 hours

  FOR APPLICATION TO YOUR AREA

  Get the **PLANNING AREA REPORT** for your locale. Scan it or read it to see how the broader recommendations presented in the Regional Report may apply to the area where you live or work.

TABLE OF CONTENTS

3. South Shore Planning Area Report

OVERVIEW v

PLANNING AREA ACTIONS MAP vii

CHAPTER 1 THEMES 1-1

CHAPTER 2 THE SETTING 2-1

CHAPTER 3 GUIDING GROWTH 3-1

The Situation 3-1, Anticipated Growth 3-1, Accommodating Growth 3-2, Guiding Growth 3-3, *Critical Environmental Areas 3-5, Developable Areas 3-5,* **The Solutions 3-6,** Priorities 3-7, Implications 3-7,

CHAPTER 4 WATER SUPPLY 4-1

The Situation 4-1, The Solutions 4-1, The Importance of Ground Water 4-1, Intermunicipal Water Systems 4-1, Meeting Long-Range Water Supply Needs After 1990 4-2,

CHAPTER 5 WATER QUALITY 5-1

The Situation 5-1, The Solutions 5-1, Water Quality and Water Supply Coordination 5-1, Preservation 5-2, Restoration 5-3, *Landfill Leachates 5-3, Watercraft Wastes 5-4,*

CHAPTER 6 OUTDOOR RECREATION 6-1

SWIMMING 6-1, The Situation 6-1, The Solutions 6-1, *Recommendations 6-1,* **SALT WATER FISHING AND RECREATIONAL BOATING 6-3,** The Situation 6-3, The Solutions 6-3, **GENERAL OUTDOOR RECREATION 6-4,** The Situation 6-4, The Solutions 6-4, **FISHERIES AND WILDLIFE 6-6,** The Situation 6-6, The Solutions 6-6,

CHAPTER 7 MARINE MANAGEMENT 7-1

AQUACULTURE 7-1, The Situation 7-1, The Solutions 7-1, **URBAN WATERFRONTS 7-2,** The Situation 7-2, The Solutions 7-2,

CHAPTER 8 FLOODING AND EROSION 8-1

The Situation 8-1, Inland Flooding and Erosion Protection 8-1, Inland Erosion 8-1, Coastal Flooding and Erosion 8-1, Coastal Erosion 8-2, **The Solutions 8-2,** Recommendations 8-2, Implications 8-3,

CHAPTER 9 LOCATING KEY FACILITIES 9-1

SAND, GRAVEL, AND STONE MINING 9-1, POWER GENERATION AND POWER PLANT SITING 9-1.

OVERVIEW

South Shore Planning Area

What is the point of the SENE Study program?

Balanced use and conservation of the region's water and related land resources is the program's objective. The Southeastern New England (SENE) Water and Related Land Resources Study was authorized and funded by Congress in response to the increasingly troublesome pressures the region's rapid urbanization was exerting on its rich and varied resources. The SENE Study has two major goals:

- To recommend actions for all levels of government and private interests to secure for the people of the region the full range of uses and benefits which may be provided by balanced use and conservation of the region's water and related lands.

- To assemble information on the resources at a consistent scale and level of detail.

What makes this Study different is that it covers a relatively large geographic area (4400 square miles), it addresses a full range of water and related land issues, and it proposes coordinated actions for all levels of government and private interests.

What does the SENE Study program cover?

The most important recommendations for this planning area include the following:

(1) To accommodate growth in environmentally and economically acceptable ways, municipalities should prohibit or restrict development on Critical Environmental Areas such as wetlands, flood plains, and well sites. Growth should be guided to Developable Areas which cover 43 percent of the planning area. Within this category, municipalities should manage development on resources such as steep slopes, ledge, and soils with septic system limitations. Development should be encouraged where services already exist or are planned.

(2) To meet the water supply needs of the South Shore's rapidly increasing population, municipalities should maintain and protect their existing well sites, reservoir watersheds, and aquifer recharge areas. Exploration for further ground water supplies and development of new surface water reservoirs will provide additional sources of water. South Shore communities should also consider forming a Water Supply District to investigate long-range potential sources of supply.

(3) To preserve existing water quality and to restore potentially polluted waters, planning area municipalities should construct advanced wastewater treatment facilities to serve high-density areas. The potential for using treated wastewater from local sources to recharge ground water in areas having the proper soil conditions should be investigated.

(4) To protect fragile beach resources, large beaches in Scituate, Marshfield, Plymouth and Duxbury should be managed locally for recreational use.

(5) To reduce coastal storm damages, high hazard areas should be zoned by the South Shore municipalities against further development. Long-term life-estate purchases of chronically damaged properties should be initiated.

(6) To provide vital energy services, sites for needed facilities should be found according to the regional policy now being developed. To meet future sand and gravel needs in an environmentally acceptable manner, communities should participate in the adoption of regulations which encourage sequential use of mining sites, improved operational criteria, and the reclamation of mined-out pits.

What will the program do?

If the recommended actions are carried out, most 1990 needs for water, sewers, electric power, and outdoor recreation could be met by making more efficient use of existing facilities, legal authorities, and institutional designs. Protecting Critical Environmental Areas will avoid potential dangers to life and property from flooding, erosion, and contamination of water quality and will provide highly productive greenbelts. As a result, new growth in this planning area can be accommodated without harming the high quality environment which attracted the growth in the first place.

You can take the first step in helping to carry out the actions by reading the recommendations in the SENE Study Regional and Planning Area Reports. Write your local planning and conservation officials to encourage them to use the SENE Study planning process when developing or implementing master plans, zoning ordinances such as flood plain and watershed protection, and other water and land use decisions.

RECOMMENDATIONS

GUIDING GROWTH (Chapter 3)

1. Protect priority Critical Environmental Areas.
2. Restrict development on other Critical Environmental Areas.
3. Manage growth on Developable Areas.
4. Use SENE resource development capability analysis to guide future growth.
5. Accommodate growth where services already exist.

WATER SUPPLY (Chapter 4)

1. Protect existing supplies and encourage water conservation measures.
2. Develop additional ground water sources to serve Rockland.
3. Form a South Shore water district or board.
4. Develop and protect ground water in six municipalities.
5. Treat existing well sources in Hanover.
6. Construct second small reservoir and act to protect well sites in Scituate.
7. Limit per capita use of water in four municipalities, if necessary.
8. Construct a new reservoir on Bound Brook in Cohasset.
9. Study long-range water supply options.

WATER QUALITY (Chapter 5)

1. Study potential for using treated wastewater to recharge Plymouth ground water.
2. Provide streambank buffer strips.
3. Establish local regulations to inhibit pond eutrophication.
4. Expand Cohasset's existing secondary treatment facility.
5. Complete an advanced treatment facility to serve Rockland.
6. Expand Plymouth's secondary treatment facility.
7. Construct a new secondary treatment facility in Marshfield.
8. Consider an advanced treatment facility on the North River.
9. Study and define the landfill leachate problem.
10. Provide pump-out facilities and treatment for watercraft wastes in coastal communities.

OUTDOOR RECREATION

Swimming

1. Secure public access to the shoreline.
2. Protect and manage Duxbury Beach, the Gurnet, and Saquish.
3. Construct parking lots along Route 3 and provide bus service to beaches.
4. Protect and manage five miles of beach in Scituate and Marshfield.
5. Encourage boat dry-storage high-rise facilities.
6. Consider fore-and-aft mooring practices.
7. Develop additional boat launching ramps in appropriate harbors.
8. Consider developing regional marina facilities in North Plymouth Harbor.

General Outdoor Recreation

9. Provide more camping and picnicking sites at Myles Standish State Forest.
10. Acquire additional access to "Great Ponds".
11. Develop guidelines for low-intensity recreation on selected storage reservoir lands.
12. Acquire the Pine Hills area in Plymouth.
13. Study the development of a trail along abandoned railroad beds.
14. Use SENE Development Capabilities Map for open space protection.
15. Designate the North and South Rivers as part of the state Scenic Rivers system.
16. Consider a visitors' center at the Route 3 North River bridge.

Wildlife and Fresh Water Fisheries

17. Use the Natural Resources Planning Program to reinforce wetlands legislation.
18. Acquire the most productive wetlands for wildlife.
19. Designate ponds 10 acres or larger as "Great Ponds".
20. Acquire public access to productive fishing ponds.
21. Acquire public access to productive streams.

MARINE MANAGEMENT (Chapter 7)

Aquaculture

1. Study aquaculture potential of estuaries.
2. Study potential for reuse of wastewater in aquaculture processes.

Urban Waterfronts

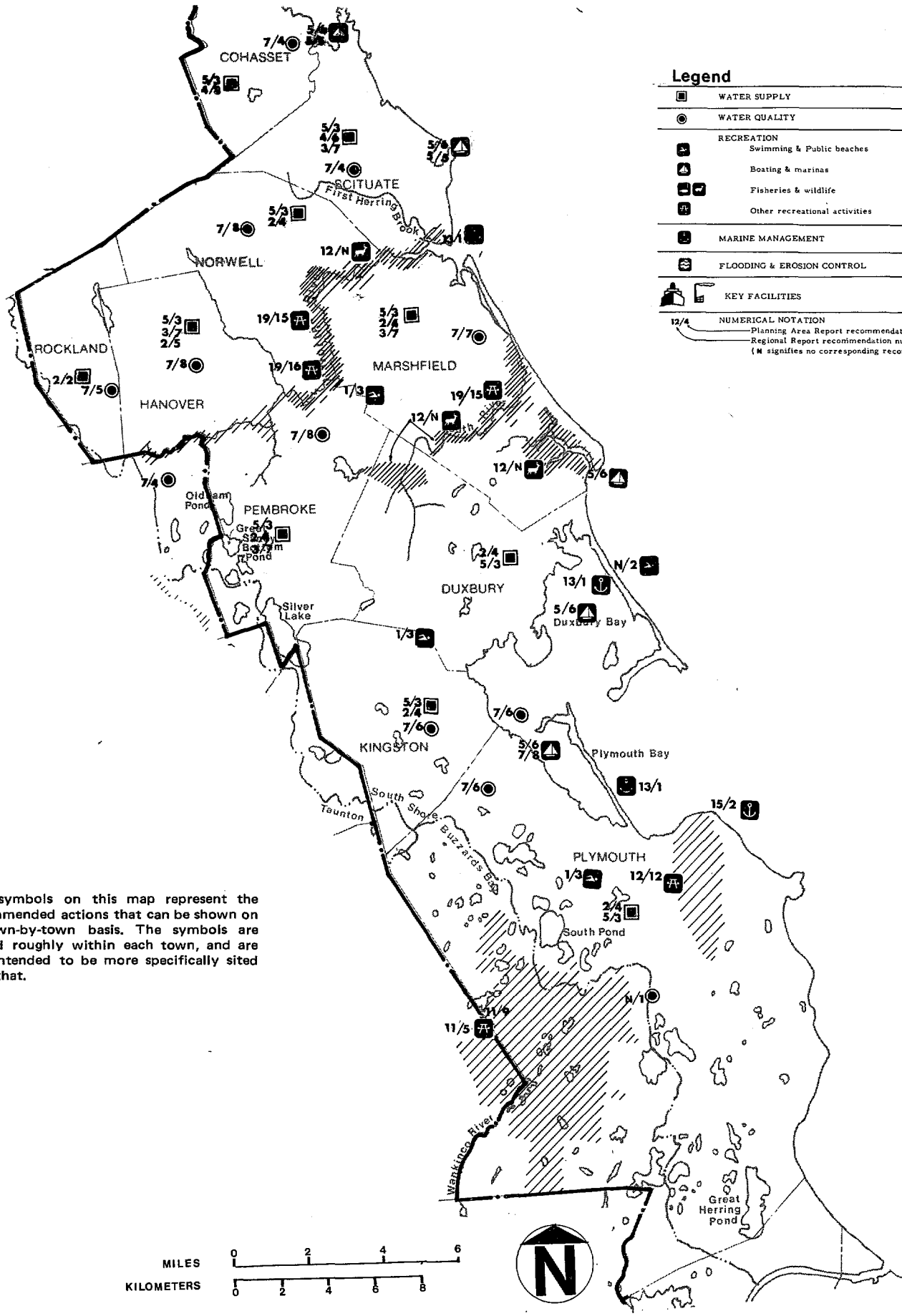
3. Coordinate local waterfront planning and development.
4. Provide guidance and set criteria at the state level for priority waterfront uses.
5. Review and coordinate waterfront use.
6. Provide federal funding for state and local waterfront development plans.

FLOODING AND EROSION (Chapter 8)

1. Develop flood plain management programs which maximize non-structural solutions.
2. Adopt local flood plain zoning preventing adverse flood plain development.
3. Establish local sediment and erosion control ordinances.
4. Establish forest buffer zones.
5. Establish local regulations to strengthen flood plain management.
6. Acquire significant flood plains and wetlands.
7. Locate in existing safe buildings in the flood plain.
8. Encourage natural stabilization of coastal erosion areas.

LOCATING KEY FACILITIES (Chapter 9)

See Regional Report, Chapter 9



Legend

- WATER SUPPLY
- WATER QUALITY
- RECREATION
  - Swimming & Public beaches
  - Boating & marinas
  - Fisheries & wildlife
  - Other recreational activities
- MARINE MANAGEMENT
- FLOODING & EROSION CONTROL
- KEY FACILITIES
- NUMERICAL NOTATION
  - 12/4 — Planning Area Report recommendation number / Regional Report recommendation number
  - (N signifies no corresponding recommendation)

The symbols on this map represent the recommended actions that can be shown on a town-by-town basis. The symbols are placed roughly within each town, and are not intended to be more specifically sited than that.

NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

South Shore Planning Area
Recommended Actions

CHAPTER 1 THEMES

This report on the South Shore planning area is one component of a comprehensive program for managing water and related land resources in the Southeastern New England (SENE) region. The SENE Study's Regional Report has presented recommended policies and actions from a regionwide or statewide perspective. This Planning Area Report includes applications of those broad-based recommendations to the cities and towns of the South Shore area.

One reason for preparing planning area reports is to connect the actions at the local level with the policy framework and considerations for state and federal levels. Action recommendations are made to individual municipalities in keeping with the emphasis of the SENE Study for placing decision making at the level closest to the problem, and in acknowledgement of the region's long history of local autonomy. The boundary of the planning area has been set along the town lines which most closely conform to the hydrologic boundaries of the drainage area.

The SENE Regional Report and each of the ten Planning Area Reports are all linked by three common themes:

- **Enhancing the environment enhances the economy.** The region's reputation as a pleasant place to live will have to be maintained in order to attract the highly skilled workers characteristic of a service economy. This need is especially clear in the South Shore planning area, which acts as living space for those who work in the greater Boston area.

- **Anticipated growth can be accommodated, but it needs guidance.** This planning area is the most rapidly growing in the SENE region and therefore communities here have a special need to plan growth.

- **Existing knowledge, programs, and institutions provide the most realistic tools for achieving results but some changes are needed.** Full use of ongoing programs, with some changes in how they relate to each other, was viewed as a way of "piggy-backing" on programs which have already weathered most of the realities of the political process. In choosing this strategy, the Study traded off novelty to increase achievability.

Each major chapter in this Planning Area Report suggests actions which ought to be taken in order to solve problems with continued growth of resource protection. Some of these problems are immediate, while others may not surface until after 1990 or, in some cases, the next century. The intensity of these various problems is set out in Table 1.1, which compares the severity of a given problem for each planning area and for the region as a whole.

Of the seven problem areas studied, five are major or severe issues affecting the municipalities of the South Shore planning area:

- **Guiding Growth.** This is the most rapidly developing of all ten SENE planning areas. Residential development is leaping ahead of some communities' capabilities to keep pace with water, sewer, or school services.

- **Water Supply.** If the area's rate of growth continues its rapid increase, many municipal water supplies will be inadequate to satisfy future demands.

- **Water Quality.** Municipal discharges into waters which have difficulty assimilating the waste loads are causing local degradation of water quality in coastal harbors and low-flow streams. Septic systems are in widespread use throughout the area. In high density development zones and in soils which cannot adequately sustain them, they have become a health problem.

- **Flooding and Erosion.** Coastal storms cause recurring damage along those portions of coastal communities which have built below the flood level or in high-hazard storm damage areas.

- **Locating Key Facilities.** Major issues exist in the South Shore planning area related to sand and gravel operations and nuclear power plant siting requirements.

Other significant problems in the planning area focus on accommodating increased recreational boating demands and on providing adequate access to the shoreline.

TABLE 1.1 GENERAL INTENSITY OF SENE WATER - RELATED PROBLEMS BY PLANNING AREA

Key

- ● **Severe problem**
- o **Major problem**
- • **Moderate problem**

Blank **Minor or no problem**

PLANNING AREAS	**GUIDING GROWTH (Overall)**	Protection of Critical Environmental Areas	Management of Developable Areas	**WATER SUPPLY**	**WATER QUALITY (Overall)**	Combined Sewers/Urban-Runoff	Municipal Discharges	Industrial Discharges	Low Streamflow	Land Use Discharge: Septic Systems	Land Use Discharge: Agricultural Runoff	Land Use Discharge: Landfill Leachate	Oil Pollution	Watercraft Wastes	**RECREATION (Overall)**	Swimming	Boating	Recreational Saltwater Fishing	Camping and Picnicking	Access to Hunting and Fishing Opportunities	Passive Outdoor Recreation	**MARINE MANAGEMENT (Overall)**	Offshore Fisheries	Shellfish and Aquaculture	Port Development	Offshore Sand and Gravel	Urban Waterfronts	**FLOODING AND EROSION (Overall)**	Inland Flooding	Coastal Flooding	Inland Erosion	Coastal Erosion	**LOCATING KEY FACILITIES (Overall)**	Availability of Sand and Gravel	Power Plant Siting	Petroleum Facilities Siting	Solid Waste Management
Ipswich - North Shore	●	o	●	o	o	•	o	•	o	●		o	•	•	•	o	●	•	●	o	o	•	●	o			o	•	•	o	•	o	o	●		
Boston Metropolitan	●	o	o	●	●	●	●	●	•			o	o	•	●	●	●	o	o	●	●	o	o		●		•	o	•	•	o	o		●	•	
South Shore	o	•	o	•	o		o	•	o	o	•			•		●	o			o	•			•			●		o	•		o	o			
Cape Cod and the Islands	o	●	•	o	•		o			●	•	•		o	•		•		o	•				•					•			o	o			
Buzzards Bay	•	●			o	●	o	o		•	o			•	o		•			•		•	●	•												
Taunton	o	●	•	o	●	o	●	●	o	o	o		•		•	●			o	•	•			•				•	•							
Blackstone and Vicinity	●	•		●	●	●	●	●	•	•		o	o		o	o	o		o	●	o	•			o	o	●	●	•							
Pawtuxet	o	•	•		●		●	●	●	•					•	●		•		o									●				o				
Narragansett Bay	o	●	●	o	o	●	o	•					o	o	•	o	o	o		o	o	o			●		•	o	o	•		o	o			
Pawcatuck	•	o			•		o	o		o				•			•			•				•				•	o		•		o	o	•	
REGION AS A WHOLE	●	o	o	●	●	●	●	●	o	o	•	•	•	•	o	o	o		o	o	o	o	o		o	•	o	o	•		•	●	o	●	o	o

CHAPTER 2 THE SETTING

The South Shore coastal planning area, located south of the City of Boston, encompasses almost 270 square miles or about 172,000 acres, and ten Massachusetts municipalities. Over the last 15 years, these municipalities have experienced the fastest residential growth of any area in the SENE region. The following communities comprise this planning area:

Cohasset	Norwell
Duxbury	Pembroke
Hanover	Plymouth
Kingston	Rockland
Marshfield	Scituate

The South Shore's coastal resources, its beaches, harbors, coastal rivers, and estuaries, are its most valuable natural assets. The North and South Rivers and the Jones River are the largest of the area's coastal streams. The North River is the longest of these tidal estuaries. While it is a mere 22 miles in length, it is unique in the region due to the distance its salt marsh penetrates inland from the sea. It provides sharp visual contrasts with its surrounding hills, and creates important scenic, recreational, and estuarine habitat conditions as a result of its unique physiographic environment. The topography of the South Shore area is generally flat, but some towns, especially those on the immediate coast, are characterized by low rounded hills and gently rolling terrain. Small ponds and lakes are abundant in the Pembroke and Plymouth area, while inland wetlands are particularly numerous in the North River watershed communities.

The South Shore's 92 mile coastline is made up of widely varied and highly scenic landforms which are significant in their diversity. Jagged, rockbound headlands in the Cohasset vicinity frame the northerly end of the planning area's shoreline. Immediately south, running from Scituate down to Duxbury and Plymouth Bays, are broad barrier beaches which shelter quiet tidal estuaries and extensive, regionally significant coastal wetlands. Coastal bluffs towering over one hundred feet high front most of the remaining shoreline south towards the Cape Cod Canal.

While only 2 percent of the SENE region's 4.8 million residents, or some 116,000 people, live in the South Shore planning area, its rate of growth has been more than six times that of the entire region. According to Study projections, it could climb by another 105 percent, to 238,000 people, between 1970 and 1990, and go to as high a population as 461,000 by 2020. The anticipated rate of growth between now and 1990 is two times higher than is expected for any other SENE planning area and four times the projected national rate for the same period. The figures could be tempered, however, by problems with transportation, developable land, the ability of services to sustain the population increase, and the availability of capital to sustain the growth.

While the overall population density of the South Shore is still one of the lowest in SENE, it is increasing its population nearly twice as fast as Cape Cod, which had the next highest growth rate and density increase in the region. Between 1960 and 1970, the South Shore's density increased nearly 50 percent, while the overall regional density increased only 20 percent.

Population density already exceeds 1500 people per square mile in the northern part of the planning area and is nearly 1000 per square mile along the coast. These densities, some of them in high-hazard coastal flood inundation areas, have caused critical problems where residents have built on unsuitable sites.

Additional problems, aside from acute commuter congestion on major highways, have affected the South Shore's resources due to this rapid influx of people. The impact of this growth has become evident in the increasing pollution of what had been among the state's cleanest waters. Coastal and riverine discharges have lowered water quality in most harbors and have degraded the North River's upstream water quality. Much of this is due to municipal discharges and to the existing coastal summer homes and increased residential development which predominate in the planning area. Despite growth pressures, 65 percent of the inland portion of the planning area remains rural, and for the most part, the landscape is a varied mixture of coastal and inland wetlands, farms, and forests.

Per capita income of people employed within the Massachusetts coastal economic subarea as a whole (in 1967 dollars) averaged about $2800, which is lower than the overall SENE average of roughly $3700. This was the lowest per capita income of any economic subarea within the region. While the SENE region as a whole averaged $300 *higher* than the national income, coastal Massachusetts areas averaged $600 *lower* than the nation, and interestingly enough, $300 *less* than the per capita income of people employed in Rhode Island's coastal area. A cautionary note should be interjected here. These incomes are average figures which give a relative order of magnitude to the income of workers employed within the *entire* coastal area of the state, and they are not meant to accurately represent the average real income of all area residents. It should be noted that most of South Shore's work force is employed outside the area, primarily in the Boston Metropolitan planning area, where workers have the highest per capita income of the region.

Of the people employed *within* the South Shore planning area, nearly half are working in retail or other service sectors, with most of the remainder employed in government or local manufacturing positions. About one tenth are engaged in local wholesale, finance/insurance, transportation, or fishing/agricultural jobs. This emphasis on a service economy is consistent with regionwide trends, but differs from the overall national trend, in which manufacturing is the largest sector with the highest employment.

Early in the Study, South Shore residents participating in workshops indicated strong support for strengthening protection of wetlands, more intensive use of existing recreational facilities, and funding more advanced sewage treatment plants to help preserve the remaining high quality waters and help clean up polluted water wherever possible. In order to meet future water supply needs, they also indicated a preference for developing controls on local consumption of water. Less enthusiastically supported was the concept of developing additional reservoirs, especially regional reservoirs, such as one discussed for the North River. The participants felt that such a proposal would be strongly opposed by the area residents due to the adverse impact on the River's estuarine habitat.

Later, during the 90-day review period, over 275 state, regional and municipal officials, federal agencies, and concerned citizens submitted comments on the Study's draft reports. The major comments are summarized in a Regional Report chapter, *"Review of the Report."*

There were three major changes in the South Shore Planning Area Report. A merger of the Abington-Rockland water supply system with the Brockton water supply system was not recommended because municipal officials and the Old Colony Planning Council advised that Abington and Rockland can develop enough supplies locally to meet future demands. The revision reflects the Study's high priority on using local sources before developing intermunicipal surface water. Instead of recommending the possibility of state acquisition and management of beaches in Duxbury, Marshfield, and Humarock, *Chapter 6* recommends local/private protection and management of coastal Critical Environmental Areas for resident and non-resident uses. This change responds to local preferences to act on these responsibilities. In response to questions of propriety raised by Trout Unlimited and the Division of Marine Fisheries, a recommendation for the state to conduct experiments to test the commercial production of coho salmon on the North River was deleted from *Chapter 7.*

Several implications can be extracted from the preceding profile:

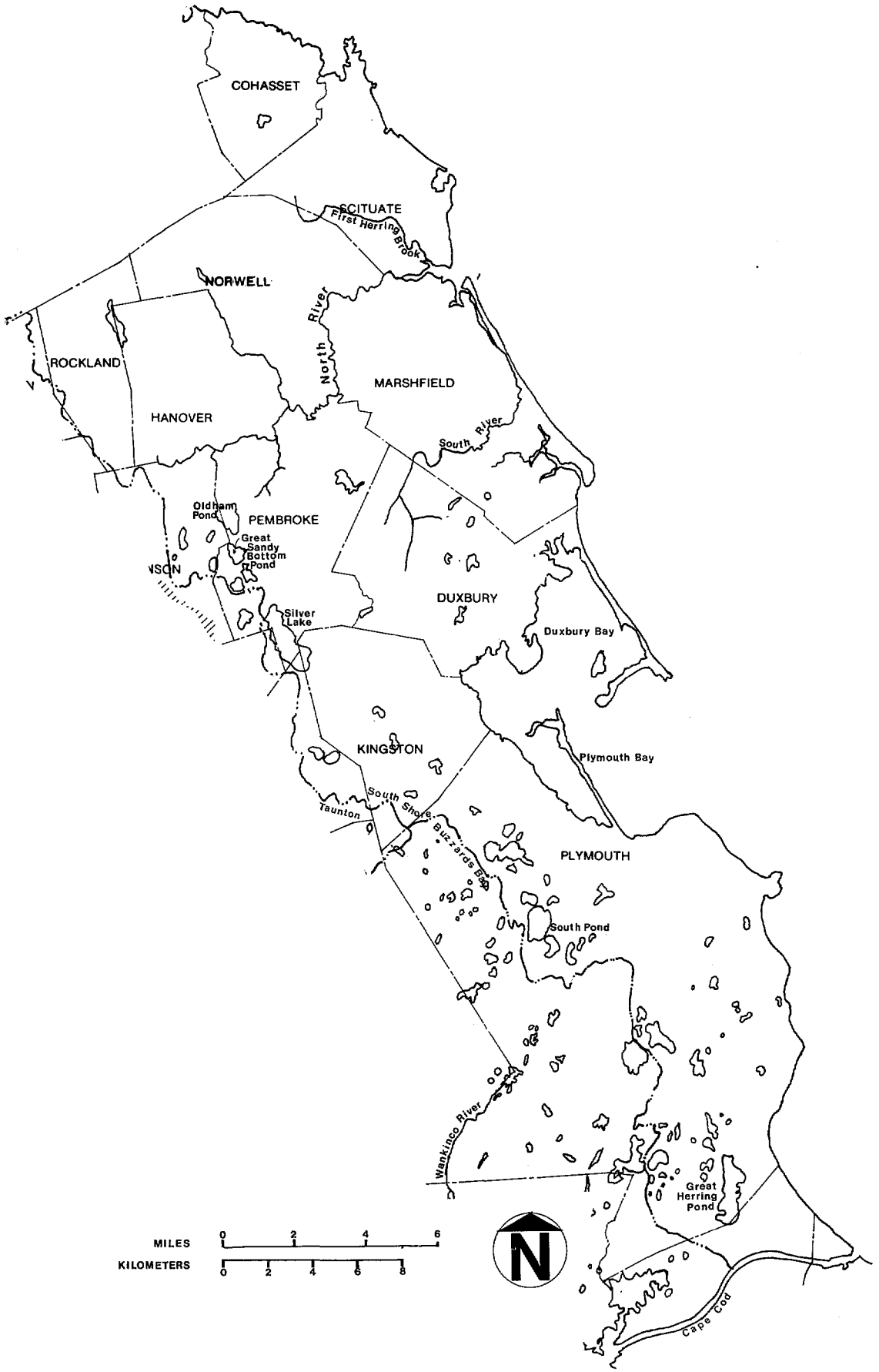
(1) The rapid rate of development in the South Shore reinforces the concept that people are seeking an improved natural environment and are willing to accept higher personal costs, in this case increased travel time and service costs, in order to gain this quality of life.

(2) The economic health of the planning area is dependent upon the Boston Metropolitan area as an employment base for much of the South Shore's work force. This income, in turn, sustains somewhat more than half of the planning area's internally employed labor force of 27,000 through service related opportunities.

(3) The South Shore's dramatic increase in residential densities has been the most rapid in the region, severely taxing local services and utilities. Although this growth has caused some localized water pollution problems, the South Shore's overall water quality is generally good, better than most other planning areas in SENE. Careful regulation of land use and the construction of advanced wastewater treatment plants in key areas are needed to keep it that way.

(4) The coastal resources of the South Shore are its most important physical assets, yet are under some of the most intense pressure for development. Critical problems have arisen as a result of existing beach front summer homes, many of which have been converted to year-round residences, which are being flooded or partially destroyed by coastal storms. Pressure is also being put on estuaries and coastal wetlands from watercraft pollution, discharges from municipal wastewater treatment plants, and filling for parking lots and causeways, and dredging for boat mooring basins. Carefully established and resolutely enforced coastal zone planning controls are needed to begin the alleviation of these conditions.

(5) Inland environmental resources, which also contribute to the South Shore's quality of life, are also threatened by insensitively-located development which causes conflicts with those resources. Inland wetlands, flood plains, important ground water recharge areas, well sites, erosion areas, best agricultural soils, steepest slopes, and soils with high water tables which limit the operation of septic systems each need to be carefully considered in site planning for various land uses.



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND WATER AND RELATED LAND RESOURCES STUDY

TOWNS AND RIVERS IN THE PLANNING AREA

FIG. NO. 2.1

CHAPTER 3 GUIDING GROWTH

Between 1960 and 1970, the South Shore planning area grew faster than any other area in Southeastern New England. In fact, its population grew nearly six and one-half times faster than did that of the entire region. Most of the South Shore's rapid growth is concentrated in the suburban sprawl which is enveloping the area's northern towns. This development jumped population by more than half, from 77,000 in 1960 to the 116,000 of 1970, while in the SENE region as a whole, population increased only 8 percent during the same period. Based on these trends, it is expected that the South Shore could continue to be the fastest growing SENE planning area, doubling its population by 1990, and ultimately reaching a population of as much as 461,000 by 2020.

This rapid growth is creating major changes in the South Shore's rural-coastal land use character. Amounts of urbanized land have increased more than 70 percent. The rural farm lands have decreased by 30 percent, as many abandoned farm fields are being carved into house lots. Despite these drastic changes, more than 68 percent of the land remains as forest, wetlands, and park or recreation lands, although these areas are coming under increasingly heavy development pressure. About 43 percent, or about 74,000 acres of the remaining unurbanized land is suitable for some sort of urbanized use. Proportionally, this is one of the *least* "room-for-growth" amounts in the SENE region.

Because the South Shore is expected to have the highest pressure for growth in all the SENE region, there is a critical need for municipalities to coordinate land use planning. Local planning boards, boards of health, and appeals boards will be hard pressed to accommodate all proposals for subdivisions and other types of development without causing further environmental degradation.

There is a growing concern among local residents that future development be located in a way which lessens conflicts with the remaining land and water resources. As pointed out in *Chapter 2 of the Regional Report,* these resources contribute greatly to the region's quality of life and its competitive economic standing with other areas in the nation. If proper steps are taken, much can be done to ensure that the quality of life will continue. This chapter describes current land use trends in the South Shore and the capabilities of its resources to accommodate future growth. It concludes with recommended strategies for guiding growth in an economically and environmentally sound manner.

The Situation

Anticipated Growth

As previously mentioned, the South Shore planning area is one of the lowest-density, yet fastest-growing of all SENE planning areas. The landscape is covered with a patchwork of wetlands, flood plains, streams, and coastal marshes which are under intense pressure for filling and development. The area's high-quality waters have begun to show signs of increasing pollution from the impacts of this development. Although the amount of land which has been urbanized, some 19 percent as of 1970, is only the sixth largest of the ten planning areas, the South Shore has nearly the least amount of remaining developable lands of any SENE planning area.

Of the land which is urban, about 68 percent is devoted to high intensity use such as commercial, high density residential, multi-family or apartment units, industry, or transportation uses. Medium-intensity uses, such as one half acre to one acre residential lots occupy about 25 percent of the urbanized area, while low intensity development (lots greater than an acre) take up about 6 percent.

The rates at which parts of the planning area will be urbanized will vary to some extent with relative development pressures. These pressures were estimated for SENE communities on the basis of a formula using factors such as the rate of growth of residential, commercial, and other uses, the relative accessibility of an area to employment and population

TABLE 3.1 MUNICIPALITY BY DEVELOPMENT PRESSURE: SOUTH SHORE PLANNING AREA

High		Medium-High	Medium-Low	Low
Duxbury	Pembroke	Cohasset	Kingston	None
Hanover	Plymouth			
Marshfield	Rockland			
Norwell	Scituate			

Note: Communities are grouped into levels of development pressure relative to other communities in the Study region and do not necessarily reflect local building activity.

in other parts of the region, and the availability of easily developable land. The precise process for grouping towns by development pressure is described in *Chapter 3 in the Regional Report.* While use of other factors, such as recent building permits or land consumption rates, may produce different results, combining the factors used gives a useful indication of development pressure in the communities in the planning area, relative to all SENE communities. Table 3.1 shows the development pressure for the planning area cities and towns.

Accommodating Growth

In 1970, about 19 percent of the total area of the South Shore was devoted to urban uses – housing, industry, schools, commercial, etc. Population and employment growth during the decade resulted in an increase in urban development of 13,000 acres, or almost 71 percent – from 19,000 acres in 1960 to 32,000 acres in 1970. For every increase of 3 persons, one acre of unurbanized land was converted to some form of urban use during the sixties.

If the urban land consumption rate of one acre for every increase in 3 persons should continue to 1990 and 2020, an estimated 41,000 acres of land would be converted to urban uses by 1990 and another 74,000 acres of urban land would be needed during the last 30 years of the forecast period. Thus by 2020, the total population expected would require a total of 147,000 acres of urban land, or 89 percent of the planning area's total land acreage.

The SENE Study inventory of land resources has identified only 74,000 acres that are suitable for future development.

TABLE 3.2 THE SENE RESOURCE DEVELOPMENT CAPABILITY SYSTEM

CRITICAL ENVIRONMENTAL AREAS REQUIRING PROTECTION

Water Bodies (Category A), blue. [Includes estuaries, shellfish flats, and fish spawning areas.]
Priority Protection Areas (Category A), dark green: wetlands, well sites, beaches, and critical coastal erosion areas.
Other Protection Areas (Category B), light green: flood plains, class I and II agricultural soils, unique natural and cultural sites, [proposed reservoir sites and related watersheds, and upland erosion areas] excluding all "A" areas.

DEVELOPABLE AREAS REQUIRING MANAGEMENT, Excluding All A & B Areas

WATER RESOURCE LIMITATIONS
Aquifers and/or Recharge Areas (Category C_1) black dots: highest yield aquifers in each basin.

WILDLIFE AND SCENIC RESOURCE LIMITATIONS
Wildlife Habitat (Category C_3), black diagonal lines: best upland wildlife habitat other than publicly owned land and [commercial fishing grounds].
Landscape Quality Areas (Category C_2), black vertical lines: land characterized by high landscape quality other than categories C_1 and C_3.

SOILS RESOURCE LIMITATIONS
Ledge and/or Steep Slope (Category C_5), brown: land with slope greater than 15 percent and/or with rock near the surface.
Severe Septic System Limitations (Category C_4), orange: land with severe septic system limitations other than Category C_5.
Moderate to No Septic System Limitations (Categories F and G), yellow: land with moderate or no septic system limitations.

PREEMPTED USE AREAS

Urban Areas (Category E), gray: residential[5/] institutional, commercial and industrial development.
Publicly Owned Lands (Category D), beige: major public parks, forests, watersheds, and military lands.

Notes:

1/ All categories above, except those within brackets, are depicted on the development capabilities maps (plates 1, 2, 3).

2/ Categories in brackets are included to show where they would fit in the overall classification hierarchy, were they included on the plates in the pocket.

3/ All categories above, including those within brackets, are depicted on large-scale, unpublished maps available for inspection as part of the SENE Files.

4/ Categories C_1, C_2 and C_3 overlap with categories C_4, C_5, F, or G. Thus, Category C_3-C_4 is a wildlife habitat located on ledge or steep slopes.

5/ Mapped urban areas (Category E) include all-residential development, although the legend on Plates 1, 2, and 3 reads "residential areas on less than one acre lots."

Such an identification was accomplished by mapping surface water, high yield ground water areas, wetlands, flood plains, soils suitable for septic systems, steep slopes, ledge, wildlife habitat, and important natural areas, among others. The mapped information was overlaid, and the most Critical Environmental Areas were identified. On the basis of the amount of land suitable for development and the past land consumption rate an estimate was made of the size of population that the planning area could accommodate.

The results of this process indicate that there is enough suitable land to accommodate growth in the South Shore only through 1990 if the past land consumption rates continue. These suitable lands may not necessarily be located where the pressures for growth are highest. Consequently, the more critical resources (those lands which due to their intrinsic suitabilities ought not be heavily developed) have been identified to provide guidance for local, regional, and state land use planners. This approach was taken so that initiative could remain at the local level for guiding development to suitable sites, while providing continued and strengthened protection of critical water and related land resources.

Guiding Growth

To properly assess the methods for guiding future growth based upon the region's water and related land resources, these resources were singled out, individually inventoried, and mapped, as previously noted. Based upon each resource's intrinsic values and on existing or proposed legislative guidelines, those with similar characteristics were grouped into broad categories.

Table 3.2 presents the various types of land uses, among which are the three major resource types: Categories A, B, and C. Two of these, Categories A and B are classified as *Critical Environmental Areas.* The most fragile and valuable of these are **Priority Protection Areas (Category A)** in which any development threatens public health, safety, and welfare: water bodies, wetlands, well sites, beaches, critical erosion areas, estuaries, shellfish flats, and fish spawning areas. **Other Protection Areas (Category B),** which can retain their usefulness only under certain kinds of limited development are: flood plains, prime agricultural soils, unique natural and cultural sites, proposed reservoir sites, and upland erosion areas.

The remaining unurbanized lands must be managed with varying degrees of regulation to protect certain values. These have been mapped on Plate 2 as **Developable Areas** requiring management (Categories C, F, and G), and include ground water recharge areas, best upland wildlife habitat, high landscape quality areas, ledge and steep slope, severe septic system limitations (Category C) and moderate to no septic system limitations (Categories F and G). Use of remaining lands (Categories D and E) is generally preempted by development or public ownership. But it is worth noting that some development areas can be used–and further, that use and reuse of such land can be highly efficient.

These land and water resources have been mapped for the South Shore planning area on Plate 2, where they have been combined with the resources of other planning areas in southeastern Massachusetts. The relative amounts of Critical Environmental Areas, in Categories A and B, Developable Areas in Categories C, F, and G, and developed or Preempted Categories D and E are displayed for the ten SENE planning areas on Table 3.3. Table 3.4 presents suggested guidelines for the suitable uses of Developable Areas mapped on Plate 2.

TABLE 3.3 PERCENT OF LAND AND WATER RESOURCE CATEGORIES IN EACH PLANNING AREA

Planning Area	Total (in 1000's of acres)	Percent (%) of Planning Area				
		Critical Environmental Areas			Developable Areas	Preempted Use Areas
		A	B	A & B	C, F, G	D, E
Ipswich-North Shore	274	19	13	32	34	34
Boston Metropolitan	421	14	9	23	30	47
South Shore	172	17	13	30	43	27
Cape Cod & Islands	378	10	23	33	32	35
Buzzards Bay	205	17	16	33	47	20
Taunton	351	19	22	41	37	22
Blackstone & Vicinity	410	10	11	21	38	41
Pawtuxet	180	11	7	18	41	41
Narragansett Bay	212	16	16	32	34	34
Pawcatuck	262	27	12	39	40	21
SENE	2,865	16%	15%	31%	36%	33%

Sources: See Methodology in the Regional Report.

TABLE 3.4 SUGGESTED* GUIDELINES FOR USE OF DEVELOPABLE AREAS SHOWN ON PLATES 1, 2, and 3

MAP COLOR / Soils Limitations	MAP PATTERN / Other Resource Limitations: NONE (color only)	High Landscape Quality (Category C_2)	Upland Wildlife Habitat (Category C_3)	Aquifer and/or Ground water recharge areas (Category C_1)
	No other Resource Limitations			
YELLOW Moderate to No Limitations for septic system disposal (Category F & G)	- PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.0 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At Least 1/2 ac/DU Unclustered - . Med. Intensity I/C . At least 1/2 ac/DU Unclustered or no PW & PS - . No I/C . At least 3 ac/DU**
ORANGE Severe septic system limitations caused by conditions other than slope and ledge soils (Category C_4)	- PW & PS . Any I/C . Any Res. - PW only . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PS only . Med. Intensity I/C . At least 1/2 ac/DU - PW only . No I/C . At least 3 ac/DU
BROWN Ledge and/or steep slope greater than 15% (Category C_5)	- PW & PS . No I/C . At least 1/2 ac/DU *** - PW only . No I/C . At least 2 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU

* These are designed to provide a framework for designing guidelines of increasing specificity by state, regional, and local planners, and consultants more intimately knowledgeable with local circumstances.

** In many cases suggested guidelines for development, particularly for ground water, are estimates of probable safe controls made in the absence of greater knowledge of the effects of development on the pollution of aquifers.

*** Erosion control measures should accompany other restrictions on slopes over 15%.

Med. & Low Intensity - refers to water use/effluent discharge/building coverage

Clustering – refers to percent impermeable land surface area which may adversely effect the resource.

PW - Public Water Supply System
PS - Public Sewer System
I/C - Industry/Commercial
Res. - Residential
ac - acre
DU - Dwelling Unit

Critical Environmental Areas comprise about 30 percent of the South Shore's total land and water area of 172,000 acres. This is only slightly lower than the regional average of 31 percent, and equals about 52,000 acres of combined A and B resource types. **Category A – Priority Protection Areas** cover about 17 percent of the planning area. Although most of these resource types are evenly distributed throughout the area, most lie within the high development pressure towns of the North River watershed. These include Scituate, Marshfield, Duxbury, Norwell, Hanover, Pembroke, Hanson, and Rockland, which also have a majority of the South Shore's inland wetlands, lakes, and ponds. The North River itself is the last major tidal estuary on the SENE coast to survive with all of its coastal and brackish wetlands in relatively intact condition. *Chapters 6 and 8* of this report discuss the value of wetlands for flood storage, water supply, plant and wildlife habitat, and other purposes. The diversity of these and other resources will be examined further in the following chapters of this Planning Area Report, but as noted above, they combine to significantly enhance the quality of life available on the South Shore.

Another 13 percent of the planning area is covered by **Category B – Other Protection Areas,** not already included in Category A resources. While other planning areas have significant amounts of inland flood plains (23,000 acres or more, on the average), the South Shore has a relatively low total of 14,500 acres. More important is the extreme danger caused in the 15,000 acres of tidal flood areas as a result of houses which have been built in these zones. Some of the highest land use densities are to be found along the beach front in Scituate, Marshfield, and Plymouth. Certain of these beaches are critical high hazard storm damage zones: Peggotty and North Humarock Beaches in Scituate, and Rexhame and Ocean Bluff in Marshfield. A recommendation in *Chapter 6* suggests that the municipalities should strive to manage and protect this critical stretch of beach. *(See Chapter 8, Flooding and Erosion in this report).* Prime agricultural lands should also be protected. They have been disappearing rapidly, representing an irretrievable loss of resource.

Developable Areas Categories C, F, and G, requiring management make up 43 percent of the remaining unurbanized area. Development on slopes over 15 percent gradient which are scattered throughout the area, can cause risk of severe erosion, undermining of foundation walls, and septic system seepage to areas below. High density development on soils with severe limitations for septic tank systems must be regulated to prevent health hazards, or provided with sewer service. If land development continues at its present rate of 0.3 acre per person, there are suitable developable lands to handle growth through 1990. Assuming a continuation of present growth rates and zoning controls, the South Shore's remaining capacity for development is 222,000 additional people. This is somewhat less than two-thirds of the expected 2020 increase in population of 345,000. However, if land consumption is figured on a regional average of 0.5 acre per person, the unused capacity drops to 148,000 additional people, or slightly more than the 122,000 increase which is forecast for 1990.

Sewer service proposed for the planning area by 1990 would serve an additional 143,000 people over 1970 sewer service. However, 52,000 people needed service in 1970. Therefore, only 91,000 of the new capacity represents new growth that can be accommodated by sewer service already planned. Severe septic tank limitations on 7,300 acres of the planning area will mean that these areas will have to be sewered or developed with septic systems at very low densities. Such acreage could be forced to support as many as 21,900 people if current pressures for their development continue to increase, causing severe health problems.

In addition to decisions about guiding future residential and concomitant commercial growth to proper sites in the area, residents of the South Shore are confronted with several problems at a more regional level. Large-scale **key facilities** and developments of more than local concern are sited here, sustaining the economic growth of the SENE region and servicing the needs of the population as a whole. Unfortunately, activities such as power plant operations and sand and gravel mining can have locally significant adverse impacts upon water and related land resources.

The demand from industrial and domestic users for power is steadily growing, but few sites exist that meet requirements for power plants with minimal degradation of the environment or safety hazards. The Pilgrim Atomic Plant is one of the few such facilities that meets most land use criteria. Sand and gravel mining in this planning area are among the greatest in SENE with large operators active, particularly in Marshfield. Frequently, however, the best sand and gravel sites are aquifer recharge areas, and care must be exercised to prevent pollution or depletion of the ground water resources. Power plant siting and sand and gravel operations are discussed further in *Chapter 9 of this and the Regional Report.*

The proposed construction of another unit at the nuclear power plant in Plymouth would, in all probability, reduce that town's tax rate and place it under even more development pressure than at present. Such an event would pose serious problems because much of Plymouth is underlain by high yield ground water reserves, which have important regional water supply potential. High density uses should not be developed over these aquifers since the permeable surface of the recharge area would be reduced, and the possibility of contamination from development would be increased. In addition, part of the rationale for location of

nuclear plants at a distance from urban areas is to keep them away from population. Yet because of lowered tax rates as a result of these facilities, growth in the town is increasing.

The proposed construction of a new Route 228 as a limited access highway through Hingham, the widening of Route 3 south of Route 18 in Weymouth from two lanes to three lanes, the construction of the proposed new Route 123 to Brockton, and the extension of the MBTA's Red Line to South Braintree, and possibly to South Weymouth or to Holbrook, would also contribute to the existing high development pressure on South Shore communities.

The Solutions

To take advantage of the South Shore planning area's potential for accommodating growth without significantly changing the overall quality of the environment, the following program is recommended: (a) Protect Category A, Critical Environmental Areas; (b) Restrict development on Category B, Critical Environmental Areas; (c) Manage growth on Category C, F, and G, Developable Areas, while guiding growth to areas with existing infrastructure.

Several methods exist for protecting the fragile or critical resources listed in Table 3.2. These include existing legislation, zoning, local building codes, subdivision regulations, purchase of easements, or transfer of development rights. Within the context of these available methods for preserving critical resources, the following action is recommended:

1. **Protect priority Critical Environmental Areas. Municipalities should prohibit urban development on Category A, Critical Environmental Areas (Priority Protection Areas). The appropriate uses of these resources include: water supply, fisheries and shellfish production, low-intensity recreation, and scenic or open space lands.**

Local planning boards and conservation commissions should protect **water bodies** from pollution by restricting adjacent development and by enacting specialized subdivision regulations which require stormwater detention ponds where feasible. *Chapter 5* of this report also makes recommendations which will help to achieve the state's water quality standards. **Tidal estuaries and shellfish flats** should be protected by prohibiting outfalls of polluting effluents and by restricting dredging, filling, or installation of pipelines. **Wetlands** should be protected through more rigorous enforcement of existing legislation by both state and local officials, (see *Chapter 6* for local assistance suggestions and *Chapter 8* for legislative improvements).

Municipalities, using Massachusetts Self-Help Funds, and private groups such as Massachusetts Audubon and Trustees of Reservations, could acquire the more valuable wetlands for wildlife or natural habitat along with their surrounding uplands as listed in *Chapter 6.* **Beaches and critical erosion areas** should be protected by zoning ordinances and selective purchase to prevent incompatible urban development, as mentioned in *Chapters 6 and 8. Chapter 6* cites two areas with particularly severe problems of erosion which also have high recreational value and suggests how to resolve the conflict.

A similar recommendation is made for the management of Category B Critical Environmental Areas needing protection:

2. **Restrict development on Other Critical Environmental Areas. Municipalities should restrict development on Critical Environmental Category B Resources (Other Protection Areas). Suitable uses to be considered for this category should include agriculture, extensive recreation, forestry, or in some cases, with proper management, very low density residential use.**

Measures for protecting **flood plains,** described in depth in *Chapter 8 of the Regional Report,* include local flood plain zoning which prohibits new development, discouraging or prohibiting reconstruction after substantial storm damages, and relocating some public facilities if structural protection is not available or practical. Structural methods required to remedy flooding problems in this planning area are described in *Chapter 8* of this report. **Prime agricultural lands** should be protected by adopting legislation which would enable towns to allow tax incentives for agricultural districts and by acquisition of development rights for the highest priority lands. *(See Regional Report, Chapter 3, for more details).*

Proposed reservoir sites and unique natural and cultural sites should be protected by outright acquisition, or purchase of easements or development rights. **Upland erosion areas** should be protected by local sediment and erosion control ordinances *(discussed in Chapter 8 of the Regional Report).*

The nearly 74,000 acres of Developable Areas (Category C, F, and G resources) require some management to retain the intrinsic natural functions which these resources perform. The SENE Study recommends:

3. **Manage growth on Developable Areas. Municipalities should manage growth on Category C resources and encourage growth on Category F and G resources, especially where infrastructure exists or is planned.**

It is worth noting that this recommendation deals with management of all developable areas, both within existing

developed areas, and in areas yet to be developed; there are no developable areas in which management of some kind is not required.

On **ground water recharge areas,** communities should restrict housing densities so that septic systems will not endanger water quality. Densities requiring sewers should be allowed only after analysis of the economic and environmental feasibility of recharge maintenance techniques to prevent depletion of the aquifer. For details about suitable uses of these lands, refer to Table 3.4. Also *see the Regional Report, Chapter 4, Water Supply and Chapter 5, Water Quality.* Other ordinances and building codes should control coverage by impermeable surfaces, require stormwater detention ponds to return runoff to ground water from roofs, streets, parking lots, and driveways. Regulations and sound engineering practices should be used to minimize the effects of activities hazardous to ground water quality such as sanitary landfill operation, highway deicing salt use, industrial waste disposal, agricultural runoff, and sand and gravel mining below the water table. On areas with **high landscape quality, best upland wildlife habitat,** and on unsewered **soils with septic system limitations,** only development of very low density or in clusters should be allowed. Development that would tend to preempt the resource value of wildlife habitat and landscape quality should be carefully evaluated to ensure that adverse impacts are fully taken into account. **Steep slopes** should be protected from erosion by low density use. Development on **moderate limitation areas** should be regulated to correspond to the availability of sewers. Higher densities should be encouraged on F and G lands.

Although local governments have much of the authority necessary to implement the concept of guiding growth based on resource capability, its implementation will be most effective if adopted as a matter of state policy. Many of the resources exceed town boundaries, and greater funding resources and information exist at the state level. The most expedient way for the states to implement these concepts would be for their interagency policy councils to review and adopt, as appropriate, the policy issues suggested in this report.

Rhode Island has taken a step in this direction by putting together a comprehensive land use plan. Massachusetts should continue to progress towards developing a comprehensive policy for guiding growth. This decision is most appropriately made by an existing interdisciplinary organization. It is therefore recommended that the Commonwealth of Massachusetts:

4. **Use SENE resource development capability analysis to guide future growth. The Massachusetts Cabinet, with the active participation of regional planning agencies and municipal governments, should review and use the SENE Study's resource development capability analysis to develop a policy for guiding future growth. Guidelines can be developed at the state, substate, regional, or local level of government.** *(See Chapter 10 of the SENE Regional Report).*

Chapter 3 in the Regional Report describes the economic inefficiencies and environmental costs of urban sprawl. Making better use of roads, sewer systems and water supply systems, where they already exist, could help to avert those costs. Therefore, it is recommended that policies be developed to:

5. **Accommodate growth where services already exist. The Massachusetts Cabinet, in conjunction with municipalities, regional planning agencies, and state agencies should establish policies to accommodate further development in already developed areas, and to permit maximum use of existing water, sewer, and transportation services. Planned unit development and the cluster principle should also be encouraged in these areas.**

The Regional Report also recommends establishment of a system for determining criteria for locations of developments of regional impact. This would be within the framework of the system designed to protect critical areas and manage others, and would enable consideration of environmental and economic justification of siting decisions. Power plant siting problems in this planning area would be under its jurisdiction. Details of this recommendation can be found in the *Locating Key Facilities chapters of this report and the Regional Report,* and *Chapters 3 and 10 of the Regional Report.* Consistent with siting criteria suggested for other facilities of regional impact, highway planners should give special consideration to avoiding Critical Environmental Areas (Categories A and B).

Priorities

While the Study encourages all municipalities to undertake this development strategy, the need is especially urgent in those towns with proportionately higher amounts of Critical Environmental Areas which will be under increasing development pressure. Based on the discussion in The Situation section of this chapter, these municipalities are: Plymouth, Duxbury, Marshfield, Pembroke, Hanover, Norwell, Scituate, and Cohasset.

Implications

The impact of these recommendations on development patterns in the planning area, considering the amounts of area in each category and projected population, should be significant. Application of SENE Study recommendations in South Shore communities can make an important difference in try-

ing to ensure that the area continues to be an attractive place to live, work, and spend leisure time. It will concurrently have the effect of preserving existing and future water supplies, improving water pollution solutions, and reducing coastal and inland flooding damages.

Although Category A and B Critical Environmental Areas comprise 52,000 acres and 30 percent of the planning area, there is adequate area left for future development. In fact, most, if not all, of the growth anticipated over the next 20 years can be accommodated on lands capable of sustaining that development with minimum environmental costs. However, major deficiencies will begin to occur in the post-1990 period, with acute shortages in remaining developable lands, water supply, and water quality control capacities.

Given present rates of land consumption, the 74,000 acres of Developable Areas will be used up shortly after 1990. This means that one of three things may happen: (1) the land consumption rate may have to change, increasing densities in some areas while ensuring protection of critical resources; (2) some of the growth will be displaced to other areas in the SENE region; or (3) some of the growth will encroach on some of the Critical Environmental Areas.

The approach recommended in this chapter emphasizes the importance of assessing the full range of environmental and economic costs which should be considered when making development decisions. Most importantly, this process shows how the costs of development to the taxpayer can be decreased, while degradation of the planning area's fragile natural resources can be prevented at the same time. While the SENE Study is not a comprehensive land use plan, the preceding recommendations represent the key steps that land use planners can take to guide the region's future growth.

CHAPTER 4 WATER SUPPLY

The Situation

The South Shore planning area is one of the fastest growing areas in the SENE region. Average water consumption in 1970 was 12 million gallons per day (mgd) and is expected to rise to 31 mgd by 1990 should current trends continue. By 1990, the maximum day demand of South Shore towns is expected to rise to 44 mgd. Rapid urbanization has had significant adverse effects on the water supply systems of many of the planning area towns. The problem was serious enough in Hanover to require a construction moratorium in the early 1970's.

However, hydrological characteristics in the southern half of the planning area afford excellent opportunities for ground water exploration. The current available yield in the planning area is 33.9 mgd, almost three times the average daily consumption.

Much of the existing supply comes from Silver Lake in Pembroke. A significant portion of the Silver Lake water supply (10 mgd) is transferred out of the planning area to the Brockton Water Commission. An additional 2 mgd is transferred to the town of Rockland. These urban areas will continue to look to the South Shore towns for future water supplies.

The remaining dependable yield available to the planning area is approximately 22 mgd. Thus it appears that, to continue exporting water to Brockton, additional sources of water supply equal to 9 mgd will have to be developed to meet in-basin 1990 average day demands. Table 4.1 is a list of recommended sources of supply for each of the towns in the planning area. Also shown are the existing safe yields of the present sources and the predicted 1990 average, and maximum, day demands of these sources should current trends continue.

The Solutions

The Importance of Ground Water

Ground water is the most economical alternative source of local water supply if such resources exist in a community, and if the community is willing to accept the necessary restrictions on land use development required to protect them. Although pockets of moderate and low urban development pressures exist in the planning area, it appears that the communities of Duxbury, Kingston, Norwell, and Plymouth will have adequate developable ground water resources to meet 1990 and longer range demands. Further utilization of ground water for public supply is likely to require treatment for iron and color. In addition, it is necessary to protect both ground and surface water sources from contamination by highway deicing salts. In Massachusetts, the Office of Environmental Affairs can regulate the use of deicing salts.

Unless they are willing to limit growth, all of the remaining municipalities will have to rely on some kind of regional water supply by 1990 in combination with existing and expanded ground water sources which may also require treatment for iron and color. The additional cost of treating ground water is generally less, however, than providing the same amount of water from surface sources. It will usually prove to be most economical for South Shore communities to protect their existing resources, as well as to plan ahead and to identify and purchase new water supply sites to preserve their future water supply options.

It is therefore recommended that the municipalities on the South Shore:

1. **Protect existing supplies and encourage water conservation measures. All municipalities on the South Shore should actively protect all existing water supplies and encourage water conservation practices in order to minimize the additional cost of supplying water and to postpone, for as long as possible, the need for developing a major new source of water within the planning area.**

Intermunicipal Water Systems

Except for very special situations, regional or intermunicipal surface water systems are generally more economical than individual local surface systems *(Regional Report, Chapter 4)*. The water needs of Rockland and a municipality in the Taunton planning area, Abington, are served by the Abington-Rockland Joint Water Works. One hundred percent of Abington's demand and a part of Pembroke's need is supplied by this system which uses Great Sandy Bottom Pond in Pembroke and a nearby well to secure 2.1 mgd of its 1970 safe yield. The remaining 1.25 mgd are supplied by local wells in Abington and Rockland and a second smaller well in Pembroke.

Consumption projections utilizing a one percent increase in per capita demand per year will result in a 1990 requirement of 6.0 mgd, close to the Abington-Rockland system's present safe yield. The recent construction of a reservoir and treatment facility on Hingham Street in Rockland and proposed development of the remaining ground water sour

ces in Abington should provide sufficient water to meet the system's needs well beyond 1990.

The SENE Study therefore makes the following recommendation:

2. **Develop additional ground water sources to serve Rockland. The Abington-Rockland Joint Water Works should explore and develop remaining ground water supplies in Abington to meet future demands in these two communities.**

As mentioned previously, ground water resources in Duxbury, Kingston, Norwell, and Plymouth are abundant and more than adequate to meet 1990 demands. Althouth areas favorable for ground water development are relatively plentiful in these communities, existing development pressures may limit their accessibility and threaten to degrade ground water quality unless protective steps are taken.

The problem of providing sufficient quantities of water for 1990 needs in the towns of Scituate, Norwell, Hanover, Marshfield, and Pembroke is aggravated by deficiencies in quality in their ground water sources. Contamination of wells is a problem in Hanover and Norwell (highway deicing salt). Solid waste leachate is also a polluter of ground water in Hanover. Iron, manganese, and color are problems throughout the swampy North River area, particularly in the ground water sources of Hanover and Scituate. Scituate is also acquiring land to change its present solid waste disposal site.

Pembroke and Marshfield apparently have adequate resources to meet their 1990 needs. Having taken steps to protect its wells and watersheds. Scituate is currently buying land for a new reservoir to satisfy its future demands. Hanover is considering treatment of its municipal wells for iron and manganese. In addition, a USGS study states that extensive exploration in Hanover indicates that any new development of significant quantity will require treatment for iron.

If the ground water is not protected, alternative sources of supply for these communities include the importation of Plymouth ground water, desalination, or construction of a water supply reservoir on the North River.

It is recommended that the South Shore municipalities undertake the following actions:

3. **Form a South Shore water district or board. South Shore municipalities should form a water district or board within the next five years to determine how the area's water resources should be allocated among various uses and municipalities. The communities in this district should also consider the alternatives for future sources of water supply.**

4. **Develop and protect ground water in six municipalities. Develop additional ground water sources to serve Norwell, Marshfield, Pembroke, Duxbury, Kingston, and Plymouth through 1990. Maximize the protection of the quality of all ground water resources in these communities.**

5. **Treat existing well sources in Hanover. Install iron and manganese equipment to treat existing wells and take the necessary steps to protect ground water resources.**

6. **Construct a second small reservoir and act to protect well sites in Scituate. The town of Scituate should construct a second reservoir on First Herring Brook, treat existing well supplies, and continue to actively protect its water supplies by land purchase. Fish ladders to allow anadromous fish passage should be provided when the reservoir is constructed.**

These recommendations should marginally be able to supply Scituate, Hanover, Marshfield, and Pembroke with adequate supplies through 1990. However, should growth in these communities be greater than expected, or should supplies become contaminated, one or more of them may face water shortages. Therefore:

7. **Limit per capita use of water in four municipalities, if necessary. Limitations on the continued growth of per capita water consumption may have to be considered before 1990 for Scituate, Hanover, Marshfield, and Pembroke.**

Cohasset will need additional sources to meet its 1990 demands. Therefore, Cohasset is now developing a surface water reservoir (2.16 mgd) which should supply its needs even beyond 1990. Cohasset is within a 15-mile radius of the State House, making Metropolitan District Commission's services an alternative for meeting future water supply needs after 1990.

It is recommended that the municipality should:

8. **Construct a reservoir on Bound Brook in Cohasset. Cohasset should develop, as it has planned, a reservoir on Bound Brook to supply its own needs. It may need to seek MDC supplements after 1990.**

Meeting Long-Range Water Supply Needs After 1990

If current consumption patterns continue (a rate of approximately one percent increase in per capita water con-

sumption per year), water supply demands in the South Shore planning area could reach 104 mgd by 2020. However, it is envisioned that the forces which affect demand, including a leveling off of population and an increasingly water conscious society, will actually result in a lower rate of increase and in somewhat lower water supply requirements. Nevertheless, even if the current trends in per capita consumption are reduced, continued water resources development will also be needed after 1990.

The construction of a large (25 mgd) water supply reservoir on the North River estuary was originally proposed in a study for the Central Plymouth County Water District as a regional source which could meet water demands of its surrounding towns after 1990. Since there is little information available on this proposal with regard to its economic feasibility or environmental impacts, and since there is significant local opposition to this proposal, the expanded Brockton regional district and reservoir appears unlikely. The South Shore municipalities might in any case find it difficult to finance such an undertaking themselves without the bond floating capacity of the Brockton urban area.

It is this Study's conclusion that the proposed reservoir *may* have serious detrimental effects on the regionally significant natural, estuarine, scenic, and historic resources of the North River. Therefore, an *investigation* of the North River reservoir or other suitable regional sources of supply should be undertaken in order to determine their environmental and economic feasibilities. Furthermore, construction of such a reservoir would conflict with the SENE Study's outdoor recreation recommendation to designate the North River as a component of the Scenic River System *(Chapter 6 of this report)* or as an Estuarine Sanctuary under the coastal zone management program.

Since other economically feasible water supply alternatives may also be available after 1990, the municipalities should thoroughly investigate them. Surveys indicate that a regionally significant ground water reservoir exists in the Plymouth-Carver area which, if properly developed in conjunction with an intertown distribution system, might be able to serve most South Shore communities. However, given the high development pressures within Plymouth, all resources may have to be utilized locally, until a study determines the excess capacities available for out-of-town supply.

The Plymouth-Carver area has also been identified by a recent study, prepared for the U. S. Army Corps of Engineers as part of the Boston Harbor-Eastern Massachusetts Metropolitan Area Wastewater Study, as suitable for the land application of treated wastewater. Additional discussion of this alternative may be found in *Chapter 5 of this report.*

While ocean disposal was recommended for the coastal communities, the Study fully endorses Section 201 of the Federal Water Pollution Control Act Amendments of 1972 which requires that before a grant is given for construction of any publicly owned treatment works that "alternative waste management techniques have been studied" including provisions for "the reclaiming and recycling of water." For this planning area, use of the effluents to control salt water intrusion into aquifers is encouraged for coastal communities where appropriate.

The location of the Pilgrim Nuclear power plant in Plymouth gives all the communities in the South Shore planning area a unique opportunity to jointly develop (if technological advancements are made – particularly in disposal of waste salt by-products generated) an economically favorable desalination facility for public water supply. The facility would use waste heat from this power plant to reduce the high energy costs of the desalting process.

In light of the above discussions, the SENE Study recommends that the South Shore municipalities:

9. **Study long-range water supply options.**
A joint study should be conducted by the recommended South Shore water supply district, or board, the Massachusetts Water Resources Commission, the Massachusetts Coastal Zone Management Program, and the regional planning agencies to examine the following options for water supply available to South Shore towns after 1990, including:

- **The feasibility of using the Plymouth-Carver ground water reservoir to supply South Shore municipalities;**
- **The additional supply saved by limiting growth in per capita consumption;**
- **The economic, environmental, and social impacts of the proposed North River Reservoir or other surface water reservoirs;**
- **The economic and environmental feasibility of using desalination in conjunction with the proposed new unit at the Plymouth nuclear facility;**
- **The economic and environmental feasibility of land application techniques for disposal of treated wastewater; and**
- **The economic and environmental feasibility of using recycled wastewater to control salt water intrusion.**

TABLE 4.1 SUMMARY OF 1990 WATER SUPPLY: SOUTH SHORE

Municipality	Existing System (1970) Source	Safe Yield[a] (mgd)	1990 Average Demand (mgd)	1990 Design Demand[b] (mgd)	Proposed Additional Source of Supply
Cohasset	Lily Pond Dug Well	0.66	1.62	same	Bound Brook Reservoir
	Hingham Water Co.	0.09			
		0.75			
	Tubular & Gravel - Packed Wells	(0.41)			
Duxbury	Tubular & Gravel - Packed Wells	2.70	2.23	4.46	Ground Water
Hanover	Gravel-Packed Wells	1.72	2.24	4.48	Treated Ground Water
	Gravel-Packed Wells	(1.65)			
Kingston	Gravel-Packed Wells	2.89	1.63	3.34	Ground Water
	Saule's Pond Wells	(0.32)			
Marshfield	Tubular & Gravel - Packed Wells	4.69	5.45	9.81	Ground Water
Norwell	Gravel-Packed Wells	1.90	1.52	3.15	Ground Water
Pembroke	Gravel-Packed Wells	1.70	1.28	2.71	Ground Water
	Abington and Rockland Water Works	0.01			
	Brockton Water Commission	0.03			
	Duxbury Water Dept.	0.01			
		1.75			
Plymouth	Great and Little South Ponds	2.00	7.57	same	Ground Water
	Gravel-Packed Wells	5.86			
		7.86			
	Gravel-Packed Wells	(0.58)			
Rockland	Great Sandy Bottom Pond	1.00	3.57	same	Ground Water and Hingham Street Reservoir
	Gravel-Packed Wells (Pembroke)	1.10			
	Gravel-Packed Well (Abington)	0.72			
	Gravel-Packed Well (Rockland)	0.58			
		3.40			
	Gravel-Packed Well (Pembroke)	(0.15)			
Scituate	Old Oaken Bucket Pond - First Herring Brook Reservoir	0.75	3.87	same	Upper First Herring Brook Reservoir and Treated Ground Water
	Gravel-Packed Wells	1.25			
	Marshfield Water Dept.	0.10			
		2.10			
	Gravel-Packed Wells	(1.06)			

[a] Ground water yield reported as pumping capacity of system. Standby supplies in parentheses.

[b] Systems relying primarily on ground water sources must supply maximum day demands.

Citizens attending advisory meetings in the South Shore planning area preferred reliance on ground water supplies to the development of a large reservoir, even if such reliance would result in the necessity for limiting consumption in the planning area.

Table 4.1 presents a summary of existing water supplies in the South Shore planning area towns as well as their projected 1990 average day and maximum day demands. Proposed additional sources of supply for each town are also listed.

CHAPTER 5 WATER QUALITY

The Situation

The intensive recreational use made of the coastal waters and inland ponds of the South Shore emphasize the need for continued maintenance of high quality waters. Given the development pressures already being experienced, this emphasis will need to be increased.

The surface waters of the South Shore planning area are of generally high quality, with a few exceptions. Cohasset and Scituate Harbors, as well as Kingston Inner Bay, have water quality somewhat lower than the standards established by the Massachusetts Division of Water Pollution Control. The largest river in the South Shore area, the North River, is relatively free from water quality problems along its tidal reaches and can be boasted as "one of the cleanest rivers" in the state. Portions of its headwaters, however, do receive inadequately treated wastewater discharges, and as a result, some recreational uses are locally limited. The existing water quality and the future water quality goals of the SENE region's major rivers and coastal waters are presented in *Figures 5.1 and 5.2, Water Quality and Supply Relationships in Chapter 5 of the SENE Regional Report.*

The major threats to achieving the water quality standards appear to be municipal wastewater discharges, since industrial discharges in this planning area are primarily cooling water, and permits for those discharges will result in best practicable treatment by 1977, and best available treatment by 1983. Such requirements will adequately protect the South Shore's waters from degradation by industrial sources of wastewater. Also shown, on *Figure 5.3 of the SENE Regional Report,* are the segment classifications of stream and coastal waters which partially indicate the degree of treatment required by industries and municipalities in order to meet water quality goals by 1977. These segment classifications, as well as the water quality classifications, have been developed by the Massachusetts Division of Water Pollution Control.

The Solutions

Water Quality and Water Supply Coordination

There are two basic areas where design and construction activities for water quality control should be coordinated with planning for water supply facilities. The first is disposal of treated effluent via land application, and the second is the location of the point of discharge from advanced wastewater treatment facilities.

Land application can be used to recharge ground water aquifers in certain limited instances where soils, climate, surficial geology, and other physical characteristics are favorable to such operations. Section 201 of the Federal Water Pollution Control Act Amendments of 1972 requires that, before a grant is given to construct a public treatment facility, "alternative waste management techniques have been studied", among which is "the reclaiming and recycling of water". While this report generally recommends ocean disposal for coastal communities, the Study also encourages municipalities which are dependent upon ground water to explore the feasibility of using treated effluent to augment recharge of their aquifers where local conditions permit.

Preliminary estimates developed for the Boston Harbor-Eastern Massachusetts Metropolitan Area Wastewater Management Study (EMMA) have indicated that several parcels of land in each of the North River municipalities may be suitable for land disposal. However, based on projected wastewater flows, land disposal sites may be too small to accommodate all the effluents. Therefore, the disposal of at least some wastewater to surface water

TABLE 5.1 SEWER SERVICE: SOUTH SHORE PLANNING AREA

Sewer System	1970 Population Served	Degree of Treatment	Receiving Waters
Cohasset	1,500	Secondary	James Brook & Cohasset Cove
Marshfield	1,500	Primary	Ocean
Plymouth	12,000	Secondary	Ocean
Rockland	13,120	Secondary	French Stream
Scituate	5,000	Secondary	Ground

appears to be the only alternative. If disposal to the North River or its tributaries is proposed, very high degrees of treatment will be needed. If ocean disposal through Marshfield is proposed, serious streamflow depletion in the planning area's rivers could result. It is obvious that more detailed comprehensive study is needed to definitely determine the proper disposal method in the North River watershed. Therefore, *the proposals presented are tentative,* based mainly on a desire to maintain high-quality in-basin water resources.

The regionally significant aquifer in Plymouth and Carver *(see preceding Water Supply chapter)* is one which would yield greater quantities of water if properly managed land application of treated wastewater were used to augment recharge without degrading ground water quality. This general area has been identified by a recent study, prepared for the Corps of Engineers as part of the Eastern Massachusetts Metropolitan Area Wastewater Study, as suitable for the land application of treated wastewater. Here is a case where integrated water quality and water supply planning at an early phase is absolutely imperative. The ramifications of improper management of this important aquifer could negate its use as a regional long-term water supply. However, properly managed application of wastewater could augment the aquifer's supplies and could add to its importance as a regional resource.

Therefore, the following action is recommended:

1. **Study potential for using treated wastewater to recharge Plymouth ground water. Land application techniques for disposal of treated wastewater in the Plymouth-Carver area should undergo a long-range feasibility study. This study should be carried out as a cooperative effort between the U. S. Army Corps of Engineers, U. S. Geological Survey, Environmental Protection Agency, and the Massachusetts Water Resources Commission, and the Department of Environmental Quality Engineering, in conjunction with the municipalities of Plymouth and Carver and other members of the proposed South Shore water supply district or board.**

Preservation

The SENE Study endorses the anti-degradation policies of the Massachusetts Division of Water Pollution Control and urges their strict enforcement in this planning area. These require that the Department of Environmental Quality Engineering should ensure that no new discharges will deteriorate the quality of the stream above the most upstream municipal discharge or to Class SA or SB waters (shellfish flats and swimmable-fishable salt water). The only exceptions should be allowed under the following conditions:

(a) to allow new cooling water discharges if standards of the receiving waters are met;

(b) to allow new municipal discharges if part of an overall comprehensive plan; and

(c) to require existing discharges to cease and either connect to a municipal system, or, if a municipal system is unavailable, to install the highest degree of treatment available so as not to degrade the high quality receiving water.

One threat to water quality is malfunctioning septic systems. These have, in many cases, resulted in the need for sewer service and attendant treatment facilities. Rigid enforcement of existing regulations may preclude many of the problems of these systems. However, an in-depth look at the criteria for locating, siting, and designing individual subsurface disposal systems is also necessary, since some aspects of existing regulations may still allow problems to develop. For example, high percolation rates coupled with the minimum allowable depth to ground water may result in bacterial contamination, nitrate build-up, or even phosphate build-up in that ground water. Also, allowing systems to be placed in fill material might invite clogging conditions at the fill-old surface interface.

Massachusetts has contemplated reviewing and updating regulations regarding individual disposal systems and there is strong public support for certain revisions *(see Chapter 5, Regional Report).* With proper enforcement, and by restricting the use of such systems to those lands suitable for septic tanks, individual disposal systems should continue to be useful for an important portion of future residential development. Without such precautions, the cumulative failure of individual systems will intensify pressure for sewer extensions and new treatment works. The result will be new concentrations of effluent in high quality streams, loss of in-basin ground water resources, increased municipal service costs, and, inevitably, the increased density of development induced by sewer service.

Increasing use of dry composting disposal units in individual residences will have important benefits, not only for water quality control, but also for water supply planning. These waterless systems could alleviate the problems of present septic systems. Actively used in Scandinavian countries over the past ten years, these dry composting systems produce only a small quantity of compost which can be removed about once a year. Wastewater from kitchen and bathroom sinks, showers, and tubs must still be disposed in septic tanks or sewer systems, however.

Another effort to prevent water pollution can be made by

the provision of streambank buffer strips. Such strips can also aid in preventing erosion *(see Chapter 8, Flooding and Erosion)*. Therefore:

2. **Provide streambank buffer strips.** **Everywhere, but particularly in communities expecting high development pressures, the Department of Environmental Management, in conjunction with other flood plain programs, should encourage municipalities to provide attractive streambank buffer strips to preserve vegetation and other natural systems which help keep non-point source pollutants from reaching sensitive water quality areas.**

In the South Shore planning area, hydrologic conditions are highly conducive to premature eutrophication of ponds which are bordered by houses using septic systems for waste disposal. Soils having high permeability, like those in this area, do not provide the necessary removal of nutrients such as nitrates. The result is a substantial increase of algal fertilization and resultant eutrophication of water bodies. This process causes degradation of ponds which are otherwise highly desirable for recreation and development of permanent and seasonal homes. The following additional action is recommended to prevent enrichment in currently unaffected ponds, and to reduce the flow of nutrients to already affected ponds:

3. **Establish local regulations to inhibit pond eutrophication.** **Municipalities should establish zoning regulations (in conjunction with new subsurface disposal regulations) that prevent use of waste disposal systems which would detrimentally alter a pond's nutrient balance.**

Restoration

Local construction programs for treatment plants designed to meet the requirements of the Federal Water Pollution Control Act Amendments of 1972 are in progress throughout the South Shore under the aegis of the Department of Environmental Quality Engineering and regional planning agencies. The projects listed will be thoroughly investigated as part of the Department's responsibilities to develop water quality management plans as required in the Federal Water Pollution Control Act Amendments of 1972. At this time, since such plans for this basin have not been completed, the following projects appear to be the most responsive to water quality preservation in the South Shore planning area:

4. **Expand Cohasset's existing secondary treatment facility.** **The new facility should serve Cohasset and should be designed with an offshore discharge.**

5. **Complete an advanced treatment facility to serve Rockland.** **The existing Rockland treatment plant should be upgraded, with a continuation of its present discharge to French Stream.**

6. **Expand Plymouth's secondary treatment facility.** **The existing Plymouth facility should be provided with a deep ocean discharge serving Plymouth and expanded to serve Kingston. Long-range design-level consideration should be given to possible further treatment and pumping for recharge via land-application on the Plymouth aquifer.**

7. **Construct a new secondary treatment facility in Marshfield.** **This facility should be provided with a deep ocean discharge and should serve Marshfield and Humarock section of Scituate and portions of Duxbury and Pembroke.**

8. **Consider an advanced treatment facility on the North River.** **Such a plant could serve portions of Hanover, Norwell, Pembroke, and possibly Hanson, with discharge to the North River below Robinson's Creek, Pembroke. Long-range design-level consideration should be given to possible further treatment and pumping for recharge via land application on the Plymouth aquifer.**

Preliminary cost estimates have been developed which include the costs of major interceptors and treatment facilities: Cohasset – $1,700,000; Scituate – $7,600,000; Rockland – $4,500,000; Kingston – $1,600,000; Plymouth – $3,300,000; Marshfield – $14,700,000; Hanover – $8,000,000; Norwell – $2,000,000; Pembroke – $1,900,000. These alternatives stress a regional approach for wastewater disposal. The larger facilities should result in cost savings as well as better operation at the plant.

Landfill Leachates. Communities which have landfill sites experiencing problems associated with surface drainage, leachate, and the lowest portion of fill being in the water table are: Marshfield, Cohasset, Rockland, and Scituate. The Norwell landfill has the first two problems and the Pembroke site the first and third. Therefore, the SENE Study makes the following recommendation:

9. **Study and define the landfill leachate problem.** **Further field investigation by the Massachusetts Department of Environmental Quality Engineering is needed to more clearly define the water quality prob-**

lems associated with existing and abandoned solid waste disposal sites.

Watercraft Wastes. Due to the extensive recreational use of the coastal waters of this basin, it is recommended that:

10. **Provide pump-out facilities and treatment for watercraft wastes in coastal communities.** The Massachusetts Department of Environmental Quality Engineering should: (a) have publicly owned treatment plants along the coast provide pump-out facilities; and/or (b) require all marinas in heavily congested harbors and adjacent to major harvestable shellfish beds and swimming areas to provide pump-out facilities with either adequate treatment or disposal to a municipal system.

CHAPTER 6 OUTDOOR RECREATION

Communities in the South Shore planning area have significant opportunities to develop major swimming, boating, camping, picnicking, and extensive outdoor recreation (trail uses, nature study) opportunities.

The North River is the least polluted river and features the least-changed estuary on the Massachusetts coast, although its headwaters are slowly being polluted by increasing urbanization. *As Chapter 3* indicated, the South Shore planning area including the North River watershed, was the fastest growing in the SENE region between 1960 and 1970. This growth should be channeled to environmentally sound yet economically feasible sites in order to enable the increased recreational and potential aquacultural use of the river.

The Humarock, Marshfield, and Duxbury beaches are the major beach resources and they must be managed, made accessible, and protected from misuse. Large tracts of forest lands adjacent to Myles Standish State Forest could be annexed and developed for hiking, camping, and other recreational facilities.

The South Shore is readily accessible from the Boston area by Route 3, which provides an opportunity for low-cost mass transit bus service and feeder parking lots which would cater to metropolitan recreation users. Additional weekend service and parking areas must be added.

The purpose of this chapter is to recommend ways of satisfying future recreational needs and of protecting the area's unique environmental quality without impairing local economic development.

SWIMMING

The Situation

About half of the South Shore coastline is usable beach for recreation, two-thirds of which is owned by municipalities, the other third of which is state or privately owned.

Projections indicate that approximately 170 acres of developed coastal beaches will be needed in 1990 to satisfy the demands of South Shore residents. In addition, the South Shore beaches will come under increasing pressure for use on a regional scale, especially from the Boston metropolitan area.

As pointed out in *Chapter 6 of the Regional Report*, problems related to satisfying swimming needs involve: inadequate access; inadequate parking, transportation, and toilet facilities at existing beaches; and erosion of beach area caused by human misuse and natural forces. Much of the South Shore's privately owned beach-front is casually used by the public. This circumstance, while adequate for local needs, is inefficient for satisfying the beach needs of the entire planning area in the long-run.

Massachusetts residents do not have a "free" right of access along the foreshore. This was confirmed in July, 1974, when the Massachusetts Supreme Judicial Court ruled unconstitutional proposed legislation to codify a general public right to the foreshore (H.B. No. 6438). The public has limited rights, dating to Colonial times, with respect to "angling" and "fowling" and navigation uses, but these need clarification in modern terms.

A Special Legislative Commission on Availability and Accessibility of Public Beaches is continuing to consider alternative ways of opening more Massachusetts beaches to the public. A current report suggests three kinds of action: equalizing parking fees at town beaches for residents and non-residents; requiring non-profit organizations holding tax-exempt status to permit public access to beach property; and automatically opening beaches and property that remain unposted and open to the public for over five years under a right of way dedication statute. There are serious problems with each of these actions; for example, the "dedication to public use" provision might well stimulate private property owners to close beach access presently unofficially open to the public to prevent loss of the private status.

The Solutions

Three options for satisfying beach needs were evaluated in Chapter 6 of the Regional Report, some of them with stronger economic implications than environmental, and others with strong environmental implications. The following recommendations represent a balance between the two extremes. They insure high quality beach bathing experiences, adequate to satisfy 1990 needs, but they are also cost-efficient.

Recommendations

The SENE study encourages the Commonwealth to:

1. **Secure public access to the shoreline.** **The Commonwealth should continue, as a matter of policy, efforts to secure public access to the coastal shoreline, with careful regard for the protection of fragile ecosystems and for minimizing negative impacts on affected communities and individuals. In view of severely limited public access rights to the foreshore, the Commonwealth should pursue an implementable clarification of the angling-fowling-navigation rights granted in Colonial times. The Commonwealth should also consider possibilities of various means of state sharing of costs of access, traffic control, facility development, and maintenance and operation in return for general public access to Town beaches. User fees should be carefully addressed as a means of direct beneficiaries bearing a portion of the cost, including use on the basis of such fees. The Commonwealth should also continue to explore other alternatives for legislation and programs to improve public access to the foreshore generally.**

Duxbury Beach is perhaps the most important of the publicly accessible beaches in the South Shore planning area. The beach, actually a narrow peninsula, stretches for more than three miles southward from the Duxbury/ Marshfield town line and faces Massachusetts Bay. Geologically, the peninsula is a barrier beach and is composed of a fragile strand of continuously eroding sand dunes, forested thickets, and extensive salt marshes and clam flats. The Duxbury Beach Association – a trust of private property owners – owns most of this barrier beach. A portion is posted as a bird sanctuary under an agreement between the Massachusetts Audubon Society and the Duxbury Beach Association. The Town of Duxbury leases the beach from the Association for town and general public use. The facility includes a large parking lot and a bathhouse located at the north end, and operated by a private concessionaire.

The southernmost tip of the peninsula hooks sharply westward and falls within the Plymouth town line. The inland, upland, and surrounding marshes (or the Gurnet) and the bayward barrier beaches (the Saquish) are privately owned and developed with summer cottages whose owners have formed the Gurnet-Saquish Corporation to serve their common interests.

Because of the critical nature of this barrier beach, the SENE Study has designated it a Priority Protection Area (see Plate 2). The Duxbury Beach Association, the Town, and the nearby Gurnet-Saquish Association have been striving to control a serious erosion problem by replanting dune grass, installing erosion barriers, and restricting vehicular traffic. However, in light of the five-fold increase in swimming demands along the South Shore planning area, the situation could worsen over the next 15 to 20 years. To cope with this problem, the SENE Study recommends:

2. **Protect and manage Duxbury Beach, the Gurnet and Saquish.** **Because of the critical nature of Duxbury Beach, the Gurnet, and Saquish, the SENE Study recommends low-intensity recreation as the most appropriate use of Duxbury Beach, with special attention to dune protection, bird habitat protection, and shellfish production. The present system of ownership and management of Duxbury Beach and adjacent lands should continue. The conservation program could be strengthened by prohibiting access to the most important bird habitats and marsh areas, prohibiting motor boat traffic in Gurnet Creek, restricting foot passage to designated trails in the dunes and to key swimming points on the beach, and, as the need arises, enlarging facilities in an environmentally sound manner at the north end of Duxbury Beach. Patrolling should be on a year-round basis by the Town of Duxbury and the Beach Association and by the Town of Plymouth, in the appropriate places. Consistent with Chapter 8 recommendations, no new development should be allowed in flood-prone portions of the Gurnet and Saquish.**

The alternatives of state acquisition or expansion by the Beach Association have not been recommended. The present system serves both public and private interests quite well. Should the cooperative efforts of the Town of Duxbury, the Beach Association, and the Gurnet-Saquish landowners – with appropriate support from the state – prove inadequate to public use or environmental protection needs, the issue of state acquisition and management will again arise.

3. **Construct parking lots along Route 3 and provide bus service to beaches.** **The Massachusetts Department of Transportation should assist in making additional opportunities for swimming available to metropolitan residents on beaches in Plymouth, Duxbury, and Marshfield by providing new parking facilities at appropriate intersections along Route 3 with shuttle bus service to the beach. No major parking lots should be built at the beaches themselves, nor should highway access routes be built. Perhaps equally as important, the feasibility of bus transportation from Boston to the beaches should be studied.**

The combined actions will satisfy at least half of the 1990 swimming demands, and fortunately, there is the opportunity to satisfy the entire need.

A five mile stretch of beach between Scituate and Marshfield is also a Priority Protection Area subject to coastal

erosion problems. This area could satisfy about half the 1990 swimming needs in the South Shore planning area. The previous report recommended state acquisition of this area and development as a regional beach. However, during the 90-day review period there was strong local opposition to this measure. To assure that the critical resources in this area are protected and the recreational values are realized, the SENE Study recommends:

4. **Protect and manage 5 miles of beach in Scituate and Marshfield. The SENE Study has found the coastal stretch north of the Sunrise Road in the Rexhame area to just north of the 4th Cliff area in Scituate to be so critical for coastal flooding and erosion that the most appropriate use is low-intensity recreation. (see Plate 2). Consistent with recommendations in Chapter 8, the town should permit no adverse development to occur in the area. If land comes on the market, the towns and/or the state should purchase and manage it for non-local and local use.**

The possibility of state acquisition is mentioned because the state has a role in assuring that unique value of the ocean beach is realized by the public. A shortage of publicly accessible beaches in this area will be of particular concern due to the proximity to the Boston metropolitan area.

Finally, natural erosion and human misuse inexorably degrade South Shore beaches. One of the Study's major recommendations *(also discussed in Chapter 6 of the Regional Report)* is for the U. S. Army Corps of Engineers, upon local and state request, to study the feasibility of stabilizing the popular Plymouth Long Beach.

If implemented, the recommendations could meet the planning area's 1990 needs for swimming and help to absorb the overflow from the Boston metropolitan area. This objective is met primarily by maximizing efficient use of existing beaches and by improving public access to the shoreline. Acquisition and development of a new public beach is costly, but crucial for satisfying future needs.

SALT WATER FISHING AND RECREATIONAL BOATING

The Situation

The South Shore's long coastline contains eight suitable harbors or anchorages for pleasure boating. Boating for recreational salt water fishing and for sailing is a major industry and facilities are used extensively throughout the season.

Salt water fishermen currently expend approximately 90,000 fisherman days in pursuit of their sport. By 1990, this demand is expected to increase to approximately 170,000 fisherman days. In addition, anglers living outside the planning area, but within easy commuting distance, will push this figure even higher.

Recreational boating needs are also related to recreational salt water fishing demands. Today, there are 15 boat launching ramps from Cohasset to Plymouth, not all of which are designed for use at low water, and some of which are in disrepair. There are 34 yacht clubs, marinas, or boat yards, mostly in Cohasset, Scituate, Plymouth, and Duxbury, which harbor more than 3300 recreational boats.

Salt water fishermen and blue cruising sailors are likely to require an additional 700 mooring spaces by 1990. The problem with meeting the needs for more permanent moorings is that there is a potential for developing only about 500 new spaces, combining the effects of marinas, slips and moorings.

Solutions to these problems appear to be increasing coastal access and the numbers of boat launching ramps. The insufficient potential for developing additional permanent mooring spaces indicates the need for more efficient use of existing marina facilities through innovative storage and mooring techniques.

The Solutions

Chapter 6 in the Regional Report evaluates several options for satisfying recreational boating demands. Some of them stress stimulating a tourist economy at the expense of commercializing the coastal environment through developing numerous new harbors. Others stress less intensive development of boating facilities at the expense of failing to satisfy the demands. The recommended approach incorporates elements of both extremes.

Highest priority in this planning area is suggested for maximizing the use of existing marina facilities. Admittedly, past experience suggests that depending on any private recreational entrepreneur is risky due to the unavailability of funds to get the business going, and high risks of failure once it is underway. Also, not much forethought has been given to suitable locations for development, to the detriment of Critical Environmental Areas and local environmental quality. To improve on these past shortcomings, the Study has recommended that the Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles, together with the Department of Environmental Management, private marina developers, and conservation interests, form a committee to guarantee loans for recreational entrepreneurs, plan for, and suggest suitable locations for development, and prepare construction standards which municipalities could enforce through building codes. This boating

committee could then advise private marina developers in the South Shore planning area accordingly.

5. **Encourage boat dry-storage high-rise facilities.** **The proposed state boating advisory committee should provide technical assistance to coastal South Shore municipalities to jointly encourage private development of onshore high-rise dry boat storage facilities, where feasible, as an alternative to dredging coastal salt marshes to provide additional mooring spaces.**

6. **Consider fore-and-aft mooring practices.** **The harbormasters should examine the possibility of instituting fore-and-aft mooring practices in protected anchorages at Cohasset, Scituate, Green Harbor, Duxbury, and Plymouth so as to decrease the mooring area needed per boat.**

One responsibility of the state Public Access Board is to acquire suitable shoreline access points and to work with the Department of Public Works to develop boat ramps and parking facilities. To satisfy the day tripper's needs, it is recommended that the state seek to:

7. **Develop additional boat launching ramps in appropriate harbors.** **The Public Access Board should acquire additional access points in Cohasset, Marshfield, Duxbury, and Plymouth and should work with the Department of Public Works to develop boat launching ramps and trailer parking lots to the same standards as the launching facility which has been built in Scituate.**

Pressures on the South Shore's marina facilities are regional in nature and there is at least one major opportunity for satisfying that demand. Therefore:

8. **Consider developing regional marina facilities in North Plymouth Harbor.** **The Corps of Engineers, in conjunction with the state coastal zone management program and/or the proposed state boating advisory committee, and communities, should consider the feasibility of coordinating federal, state, and private interests in the planning of marina development in North Plymouth Harbor.**

Failing to implement these recommendations could lead to marina development which is inadequate to satisfy demands of recreational boaters, which fits inappropriately into the local infrastructure or Critical Environmental Areas, and which may not provide a quality experience, an important characteristic of boating activities.

GENERAL OUTDOOR RECREATION

The Situation

People who live in the South Shore planning area use water and related land resources for extensive outdoor recreation: nature study, trail use, casual picnicking, canoeing. Campgrounds and picnic facilities are used by tourists, though likely to a lesser degree than Cape Cod and Narragansett Bay. Nearly 10 percent of the planning area is used for public recreation and with a relatively minimal effort, will be nearly adequate for satisfying future needs for "general" recreational purposes. The Bureau of Outdoor Recreation (BOR) estimates that campgrounds in the planning area could satisfy about three-quarters of the planning area's 1990 demands for camping (over 200 additional campsites are needed); existing picnic facilities could satisfy about three-quarters of the total demands for picnic facilities (roughly 150 additional picnic tables are needed); and existing parks and conservation areas could satisfy nearly all the planning area's 1990 demands for extensive outdoor recreation, although Boston's unmet needs, especially for the third category of activity will place increased pressure on this planning area's resources.

The Solutions

The kinds of options available for satisfying these recreational needs have been evaluated in *Chapter 6 of the Regional Report.* The recommendations for the South Shore planning area are cost-efficient, could satisfy the demands, and needless to say, contribute significantly to maintaining the planning area's high quality of life.

The most desirable action for satisfying needs for camping and picnicking facilities is to expand and develop an existing state park. Therefore:

9. **Provide more camping and picnicking sites at Myles Standish State Forest.** **The Massachusetts Department of Environmental Management should expand facilities and develop additional campsites and picnic facilities at Myles Standish State Forest.**

To completely satisfy future camping and picnicking needs, the private sector, under the guidance of a state recreational advisory committee described in *Chapter 6 of the Regional Report* and an earlier section of this chapter, could develop more facilities adjacent to lakes and ponds. This guided development should be coordinated with efforts to enlarge access to lakes and ponds and to develop boat ramps near them. Through Great Ponds legislation, recreational use of natural ponds larger than 10 acres is already a public right. The numerous ponds in the South Shore planning area

could provide opportunities for swimming, boating, and fishing. Therefore, the recommended course of action is:

10. **Acquire additional access to "Great Ponds".** **The Public Access Board should acquire additional access to Great Ponds, especially in Plymouth and Pembroke.**

Water supply reservoirs in parts of the South Shore planning area represent quasi-wilderness amidst the region's highest development pressures. They have persisted as such because water authorities, legally bound to protect the quality of drinking water supplies, prohibit trespassing for any purpose. However, the experience of water managers in parts of Massachusetts and Connecticut is that low-intensity recreation on watershed lands (particularly those related to storage reservoirs) is compatible with the production of potable water. Because finances large enough to acquire natural areas of equal quality and size are difficult to pull together, social pressures for recreational use of reservoir watershed lands will mount. To satisfy extensive outdoor recreation needs, the following action is encouraged:

11. **Develop guidelines for low-intensity recreation on selected storage reservoir lands.** **The Departments of Environmental Management and Environmental Quality Engineering should develop guidelines and regulations regarding the use of storage reservoirs for low-intensity recreation** *(proposed in Chapter 6 of the Regional Report).* **Local water authorities should use them to select storage reservoirs and plan for recreational activities.**

A noteworthy natural area in Plymouth is the Pine Hills area which would be acquired for conservation purposes, and, with proper management, used for camping and picnicking. It is therefore recommended that the local conservation commission should:

12. **Acquire the Pine Hills area in Plymouth.** **Using Land and Water Conservation Funds, Plymouth should acquire the Pine Hills area and should look into turning over camping and picnicking management to a private entrepreneur, or should operate such facilities to gain income for the municipality.**

One of five Trail Advisory Committees in the Commonwealth should assess the planning area's potential trail resources and advise DEM about the location and best use of several opportunities. Two particularly attractive options are the following:

13. **Study the development of a trail along abandoned railroad beds.** **The District Trails Advisory Committee should evaluate trails along the abandoned railroad right-of-way from Hingham to Kingston and Plymouth to Taunton, and advise the Department of Environmental Management about appropriate uses and designs.**

Plate 2 shows the locations of Critical Environmental Areas, which, as *Chapter 3* explains, have important roles in natural processes such as riverine and coastal flooding and erosion protection, water supply, and wildlife protection. These areas require protection. They can also be used for a variety of low-intensity recreation activities. Since protection and development of such resources is best coordinated at the local level, municipalities should:

14. **Use SENE Development Capabilities Map for open space protection.** **Municipalities should plan Critical Environmental Areas (shown on SENE Development Capabilities Map, Plate 2) for open space protection and greenbelt programs. Methods for protecting such resources without outright acquisition are described in** *Chapter 3 of the Regional Report.*

If implemented, the Bureau of Outdoor Recreation estimates that these actions could provide enough campsites and picnic facilities to meet nearly the total 1990 needs for extensive outdoor recreation. Options to develop fewer recreational resources were not recommended because the opportunity to absorb the enormous unsatisfied demands from the Boston metropolitan area must not be foregone. Furthermore, the recommendations stress the enlarging of existing facilities or the improvement of recreational opportunities in areas already publicly-owned, such as water supply watershed lands. This approach saves the cost of acquiring large amounts of natural areas. Participants in the South Shore Public Workshop strongly favored the idea of intensifying the use of existing facilities and using public recreation facilities for multiple recreation activities.

High Priority State Scenic River Corridor. The North River is the largest and most scenic coastal river on the Massachusetts coast south of the Merrimack River. It is one of the cleanest in the state and is returning to much the same natural condition as in its pre-colonial days. During the 1700's the North River was one of the nation's foremost shipbuilding sites. This site produced, among others, the Boston Tea Party ship "Beaver" and the "Columbia," the first American ship to sail around the world. Today, its linear corridor bisects the fastest growing area in eastern Massachusetts and, predictably, development pressures on this historic and scenic corridor are intense. The Department of Environmental Management and local governments have an outstanding opportunity to preserve this regionally signi-

ficant corridor and protect its recreation, scenic, and historic values.

The central reach of the river has excellent accessibility from the Boston metropolitan area via Route 3, which crosses the river and provides scenic turnouts and parking. This Route 3 rest area presents a singularly unique opportunity to establish a controlled access point to the river to satisfy a portion of the unmet recreational demands of other SENE planning areas, such as the Boston Metropolitan planning area.

However, due to the fragile nature of the scenic corridor's extensive marshes and wetlands, recreational activities should be restricted to those which will not adversely impact those resources and cause irreversible damage. Powerboat wakes and ice scouring during spring thaw have accelerated the undercutting of the saltmarsh riverbanks. Erosion rates exceed 3 feet per year, and the loss of marshland has increased considerably over the past 10 years. Citizen groups such as the North and South Rivers Watershed Association have recently been active in demonstrating renewed public interest in canoeing and other extensive recreational activities, as well as coordinated watershed-wide planning on a town-by-town basis. Because this unique resource is facing the highest development pressure in all of the SENE region, the state should take immediate steps to:

15. **Designate the North and South Rivers as part of the State Scenic Rivers system. The Department of Environmental Management should implement the State Scenic Rivers Act in Massachusetts by designating the North and South Rivers as priority components of the system, and the Massachusetts Coastal Zone Management Program should pursue its application to the National Oceanic and Atmospheric Administration (NOAA) to designate the North River area as an estuarine sanctuary under the Coastal Zone Management Act, with provision for allowing existing recreational activity to continue.**

16. **Consider a visitors center at the Route 3 North River bridge. The Department of Environmental Management, in cooperation with the North and South Rivers Watershed Association and the South Shore Science Center, should consider establishing a visitors center and scenic overlook at the Route 3 North River rest area incorporating historic, natural science, and wildlife displays unique to this significant resource.**

FISHERIES AND WILDLIFE

The Situation

Most of the South Shore planning area is fairly open – over 75 percent of the area is either forest land, agricultural land, wetlands, or open water. Over 80 percent of the forest land is rated fair wildlife habitat and 63 percent of the planning area's wildlife habitat is open to hunting. Fourteen thousand, two hundred (14,200) acres are publicly owned and open to public hunting; another 65,000 are privately owned and open to hunting. It is estimated that by 1990 residents of the South Shore area will spend 140,000 and 420,000 recreational days, respectively, on hunting and fresh-water fishing. The amount of accessible wildlife habitat in the planning area could satisfy 32 percent of this demand. Thus, insufficient fish and wildlife habitat and a general lack of public access to the existing resource base are the major factors limiting fulfillment of demand. Due to the close proximity of the South Shore basin to the Boston area, much of the largely unmet hunting demands of the metropolitan area will be directed to this basin.

Of the 95 (4,988 acres) fresh water ponds, 10 acres and over within the basin boundaries, only 8 (968 acres) have guaranteed state-wide public access. Of the 50 miles of stream the amount in public ownership and open to fishing is negligible. If these waters had adequate public access and were under fishery management, they could support an estimated 290,000 man days of fishing, about 70 percent of the 1990 planning area demand.

The Solutions

Chapter 6 of the Regional Report describes four options for satisfying the planning area's future demands for wildlife, and two options for future fishing demands and their implications. The following recommendations are based on an evaluation of those options.

Due to the multiple benefits of wetlands for flood reduction, water quality, and wildlife production, the Study has recommended their protection to the maximum extent. This can be done without impairment to economic growth *(see Chapter 3 of the Regional Report)*. The Wetlands Protection Act gives municipalities a substantial amount of authority in deciding whether or not alteration of wetlands should be permitted, but often their efforts are frustrated by inadequate legal backup and expertise. Recently, the Soil Conservation Service has developed a program whereby communities can get technical information about wetlands (and other natural resources) through Conservation District Offices. Because municipalities can protect significant

amounts of wetlands through legislative channels, the Study encourages their responsibilities with this recommendation:

17. **Use the Natural Resources Planning Program to reinforce wetlands legislation. Municipalities should use technical information provided by Natural Resources Planning Program, administered through Conservation District Offices, to enforce the existing wetlands legislation.**

Outright acquisition is the safest assurance that wildlife habitats will be protected and the state's responsibilities are to purchase those areas of regional significance, specifically the North-South River tidal estuaries and the Dyke Meadow area *(Chapter 6, SENE Regional Report).* However, smaller wetlands and adjacent or separate uplands are often the most productive habitats, and frequently municipalities prefer to control them. Hence, the following recommendation:

18. **Acquire the most productive wetlands for wildlife. Communities, using Self-Help Funds, and/or private interests should acquire wetlands most important for wildlife production** *(identified on SENE Study single-purpose inventory maps available at NERBC)* **throughout the planning area.**

Edges between forest, field, and wetland are often the most productive wildlife habitats. Some of the Study's major policies involve the protection of prime agricultural soils, wetlands, flood plains, and unique natural areas (collectively Critical Environmental Areas). Actions to protect these resources – *described in Chapter 3 of the Regional Report* – have secondary benefits for the wildlife enthusiast or hunter because they preserve wildlife habitat.

Productive fresh water fisheries exist in the planning area's ponds, lakes, and streams. The Massachusetts Division of Fisheries and Wildlife has an active program of streambank acquisition. The Public Access Board is legally charged to acquire public access to "great ponds" (those natural ponds 20 acres and larger) for fishing, and those natural ponds 10 acres and larger for other recreational purposes. Public water supply reservoirs, previously discussed in this chapter, are also productive fishery habitats. To ensure the availability of fresh water fisheries for future generations, the state should:

19. **Designate ponds 10 acres or larger as "Great Ponds". The Massachusetts legislature should change the existing Great Ponds Act to designate ponds 10 acres and larger "great ponds" for fishing.**

20. **Acquire public access to productive fishing ponds. The Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles should evaluate ponds having "good" or "best" fishing potential and acquire access to them. The SENE Study's Single-Purpose Inventory (available from NERBC files) has identified 14 ponds which have the highest potential: Great Pond Reservoir, Braintree and Randolph; Whitman Pond, Weymouth; Accord Pond, Hingham-Norwell-Rockland; Great Pond, Weymouth; Oldham Pond, Hanson-Pembroke; Wompatuck Pond, Hanson; Maquon Pond, Hanson; Furnace Pond, Pembroke; Indian Head Pond, Hanson-Pembroke; Great Sandy Bottom Pond, Pembroke; Silver Lake, Halifax-Kingston-Pembroke; Island Creek Pond, Duxbury; Little Pond, Plymouth; and Great Herring Pond, Bourne-Plymouth.**

21. **Acquire public access to productive streams. The Massachusetts Department of Fisheries, Wildlife, and Recreational Vehicles should acquire streams in the South Shore planning area which have "good", "best" fishing potential. The SENE Study's single-purpose inventory has identified four streams with the highest potential for productivity: North River, Marshfield and Scituate; Indian Head River, Hanover and Pembroke; Jones River, Kingston; Beaver Dam Brook, Plymouth.**

Precautions must be taken so that these resources are not overexploited. The access points can be as simple as a public easement trail across private property indicated by a sign, with parking on town roads. Larger roads and boat ramps in some areas would be inappropriate for some particularly sensitive water bodies.

Management practices, if implemented, on Critical Environmental Areas would greatly improve the quality and productivity of wildlife habitat. If properly managed these lands could support approximately 74 percent of projected 1990 demands.

Information was not available to ascertain the effectiveness of options such as arranging state management of privately-owned wildlife lands in exchange for public access, or the possibility of enlarging the boundaries of state hunting areas. Past experience indicates that most wildlife enjoyment occurs on privately or quasi-privately owned land. The option to arrange public access to private wildlife habitat was not recommended, first, because of the expense involved and, second, because public preferences expressed at the South Shore public workshop did not support the idea of public access to privately-owned land.

Creating new wetlands was not recommended because the high costs involved in initial outlay would be better spent in acquiring wetlands which already exist and are known to be highly productive.

CHAPTER 7 MARINE MANAGEMENT

The major marine related issue in the South Shore planning area concerns shellfish, aquaculture, and urban waterfronts. Although discussion in this Planning Area Report will deal only with these topics, additional information on other marine related issues can be found in the *Regional Report, Chapter 7, Marine Management.* That chapter discusses recommendations on the 200-mile limit, developing the region's aquaculture potential, the need for a deep water port strategy, controls on mining offshore sand and gravel, and good examples of planning for urban waterfronts. A more specific discussion of Plymouth's waterfront potential, which is summarized below, can be found in *"Urban Waters Special Study"*, a separate SENE Study report available from NERBC.

Additional marine related topics, such as recreational boating, beach swimming, coastal access, and salt water sportfishing can be found in *Chapter 6, Outdoor Recreation of this report, or in the Regional Report.* Similarly, discussions on power plant siting in coastal areas, and regional petroleum needs, including implications for tank farms, are to be found in *Chapter 9, Locating Key Facilities, of both this report and of the Regional Report.*

AQUACULTURE

The Situation

The North River has been identified as the estuary having the greatest potential for anadromous fish restoration in the state by the Massachusetts Division of Marine Fisheries. The Indian Head River, main tributary of the North River, was selected for an experimental introduction of coho salmon into Massachusetts waters in 1971. This project was intended to test the feasibility of establishing a marine sport fishery for coho salmon. The commercial viability of coho aquaculture has been amply tested and proven feasible on the West Coast. The technology of coho salmon aquaculture is available and needs only to be translocated to the East Coast. It is the Division's position that, if commercial coho salmon aquaculture is needed or justified on the East Coast, this should be carried out by the private sector, since preliminary feasibility research has already been accomplished.

The Indian Head River and many other tributaries in the North River system currently possess some of the highest water quality (Class "A" or "B") in the region. They have exhibited great potential for smelt populations, and there have historically been large runs of alewife and shad, creating an excellent sport fishery. The mouth of the North River estuary has extensive shellfish beds supporting softshell clams and blue mussels and also hosts large runs of striped bass, a very popular game fish.

The Solutions

Research on marine aquaculture has indicated that the species which could withstand climatic and production rigors and still make economic returns are: the American oyster (which has been cultured in varying degrees in this country for over a hundred years); the hard clam (quahog); bay scallop; silver (coho) salmon; and American lobster. All but the salmon (which has been proven to thrive here) are native to the area, all have been successfully cultured through every life stage to market size, and all have considerable market value.

These are six farming zones in coastal environments: shore, intertidal, sublittoral, surface floating, mid-water, and seabed. Research has shown that preference should be placed on sites located in protected areas. Extensive culture operations require large land areas for ponds, whereas intensive culture demands dense propagation per unit area. Because the availability of suitable coastal areas on the South Shore is limited to protected embayments, intensive culture would be used for these waters in order to provide continual optimum conditions for growth and development. Aquacultural operations can interfere with natural processes, but in Massachusetts there is legislation which addresses means of resolving this potential conflict. The following recommendation is made:

1. **Study aquaculture potential of estuaries.** **Consistent with SENE Development Capabilities Maps and with criteria discussed in** *Chapter 7 of the Regional Report,* **the Division of Marine Fisheries should verify the suitability of the following areas for intensive aquacultural leasing potential: Brigg's Harbor in North Scituate; South River estuary; Duxbury Bay; and Plymouth Bay.**

Although some South Shore estuarine areas have competing uses from industrial and municipal wastewater facilities, aquaculture can be managed as a symbolic user of coastal areas in conjunction with wastewater treatment facilities (a source of nutrients) and power plants (an inexpensive source of heated water). There is potential for introducing innovative reuse of heated wastewater at the Pilgrim Nuclear Power Plant. This nuclear plant is adjacent to Plymouth Bay and could serve as a potential source of heated

water for shellfish or finfish propagation. In view of this, the following action is recommended:

2. **Study potential for reuse of wastewater in aquacultural processes. The New England Regional Commission, with technical support by the state, should fund research into the feasibility of using heated cooling water from the Pilgrim Power Plant to support aquacultural operations. Special attention should be paid to possible contaminants in the cooling water. These agencies should support continued research, such as that at Woods Hole Oceanographic Institute, to find techniques for the removal of viral and bacterial contamination.**

The Federal Water Pollution Control Act Amendments make thermal pollution illegal. With this assurance, Pilgrim, a coastal, nuclear plant, may be an important site in New England for this form of aquaculture.

For further discussion on aquaculture recommendations, impacts and benefits, *see "Aquaculture and Shellfish Management" in Chapter 7 of the Regional Report.*

URBAN WATERFRONTS

The Situation

New England's port cities were largely responsible for the area's rapid economic growth and development in the eighteenth and nineteenth centuries. As noted in New York's "Waterfront Workshop" conducted by the City's Planning Commission in 1974:

> "Time and technology have left stranded many once-busy segments of the waterfront. Brickyards, stoneyards, lumberyards, and coal terminals have either gone out of business or moved elsewhere. Containerization has shifted the volume of shipping business, and airlines and cruises have transformed passenger ship piers.
>
> "These changes have opened up the waterfront's potential, although in a double-edged fashion: because one type of development usually precludes all other alternatives, proposals may generate counter-proposals. A housing plan is met with the suggestion that a park would be preferable, a plan to site industry may arouse environmentalists, a plan to turn over an idle pier for recreation may be attacked as a blow to shipping. Almost everyone agrees that the shoreline is too valuable to be allowed to lie fallow, but agreement on a specific plan may be difficult to obtain. This is one of many contradictions enshrouding the waterfront."

In order to recapture the vitality which lies just beneath the surface of decay and neglect, a few institutional and administrative changes are needed, backed by public awareness. Several cities and towns have initiated or carried out sound programs for waterfront development or renewal, although their success has occurred in spite of, rather than because of, current institutional and public policy.

Plymouth is probably the South Shore's best example of this success. This town's unique heritage has made portions of its waterfront, especially at Plymouth Rock and the Mayflower Replica, major tourist attractions. In addition, the Plymouth Harbor sustains a high level of recreational boating. However, supporting tourist and recreation-related facilities are lacking since in the past the town has not actively pursued an overall development program for capitalizing upon its tourism or recreation potentials. Recently, Plymouth enacted a zoning bylaw which includes a unique "Waterfront District" to promote the development of land uses and activities appropriate to the waterfront.

Still in its infancy, Plymouth's new zoning bylaw, the associated Design Review Board and the Waterfront Zoning District offer the opportunity for guiding future waterfront development. (For a more detailed review of these and other bylaws, *see "Urban Waters Special Study", available from NERBC.)* Although the zoning provisions are inherently only a review function, they could be combined with a more active town role in redeveloping key sites along the waterfront. One such site was recently offered to the town by the Plymouth 350th Anniversary non-profit corporation. Growing demands for tourism and waterfront recreation uses provide a basis for such improvements of Plymouth's waterfront.

The Solutions

By integrating master planning and developmental control functions in the urban waterfront area, local governments can focus public interest and concern on relevant development issues and establish an administrative framework at the local level. In light of the previously discussed options, the following actions are recommended in order to enhance the reuse of urban waterfronts in a rational and balanced manner:

3. **Coordinate local waterfront planning and development. Municipalities should prepare an inventory or plan for the long-term use or reuse of waterfront areas. In undertaking such activities, cities and towns should give special consideration to factors such as the protection of flood prone areas, the preservation and enhancement of historic sites and buildings, the provision of public access easements (both physical and visual) in new development, building height, and so forth, consistent with Critical Environmental Areas as specified in *Chapter 3, Guiding Growth.***

While primary responsibility for initiating and carrying out land use decisions should remain at the local level, the state should perform the following critical functions:

4. **Provide guidance and set criteria at the state level for priority waterfront uses.** **Massachusetts, through its coastal zone management program, should develop urban waterfront planning and management guidelines, and criteria for deciding priorities for uses to be incorporated into local waterfront master plans. Priorities should be established for water-dependent uses, water-using uses, complementary uses, and low-priority uses.**

5. **Review and coordinate waterfront use.** **Massachusetts, through its regional planning agencies, and Department of Community Affairs, should exercise its powers to review and revise major waterfront development proposals of more than local concern.**

At the federal level:

6. **Provide federal funding for state and local waterfront development plans.** **The U. S. Congress and the Office of Management and Budget should approve adequate federal funding for state coastal zone planning programs, and for other planning programs which enhance waterfront redevelopment.**

Implementation of coordinated local and state approaches should help to minimize fragmentation of decisions in waterfront areas while recognizing the appropriate roles of the different levels of government. Agreement on appropriate guidelines and priorities should help to reduce conflicts between uses and increase the chances for a variety of uses along urban waterfronts.

More sensitive and sensible use of waterfronts will reinforce use of existing infrastructure and help to reutilize urban areas which have considerable economic and aesthetic potential.

CHAPTER 8 FLOODING AND EROSION

Previous riverine floods in the South Shore area have, for the most part, caused minimum physical damage with little danger to the population. Data from the three established gaging stations show that the flood of March 1968 was the most notable in recent years. Excess flooding can occur in the planning area during any season, particularly with high streamflows in the spring. Coastal flooding is a greater problem, particularly in the northern coastal towns of the planning area, and the storm of February 1972 was particularly devastating to these areas.

Uncontrolled land use in the planning area and the loss of existing flood detention areas will increase flooding frequency. Residential and industrial expansion which in any way reduces the storage capacity of natural bogs, swamps, marshes, and ponds will increase potential flood damages in the planning area which, at present, are at a relatively low level.

In general, the Study's recommendations urge that both upland and coastal flood prone areas be protected from development by using non-structural solutions wherever possible, such as maximizing use of wetlands for flood storage and applying strict development criteria. Only where there is high value development in small concentrated areas should development be protected from flooding by using structural solutions. Recognition of the multiple values of wetlands – not just as natural flood retention areas, but for wildlife habitat, water supply, recreation, and landscape quality as well – further strengthens the importance of wetlands protection as a means of reducing flood damages.

The Situation

Inland Flooding and Erosion Protection

Extensive wetlands in the planning area – nearly 12,000 acres of inland wetlands (both open and wooded) and approximately 5,000 acres of coastal wetlands – offer significant opportunity for non-structural management of flood plains. Riverine flood plains, which overlap many of these wetlands, total some 14,600 acres.

There are more than 7,000 acres of significant inland wetlands throughout the North River watershed communities along (Scituate, Marshfield, Norwell, Pembroke, Hanover, Hanson, and Rockland). This natural valley storage is helping to restrain potentially damaging flood flows. Loss of flood plain storage through destruction and filling of wetlands has occurred most significantly in Hanover along Route 53, although losses have occurred, and continue to occur, throughout the South Shore.

Inland flooding, although frequent, is not yet a serious problem. However, the increasing urbanization of the area and wetland destruction increase the potential for flood damages. Since population growth and development pressure are expected to be high, steps should be taken to establish state/local cooperation in wetlands protection to preclude potentially extensive flood damage. The largest flood plain and inland wetland complexes in the planning area occur along Bound Brook in Cohasset, Scituate, and Norwell; the Drinkwater River in Hanover and Rockland; in Pembroke along Herring Brook, Pudding Brook, and the North River; in Hanover and Norwell along Third Herring Brook; and in Scituate along First Herring Brook. These wetlands and flood plains have been included on the SENE Development Capabilities Map (Plate 2) under categories "A" and "B" of the Critical Environmental Areas for reference by the state and localities. They represent *high priority areas* for protection based on development analysis.

Inland Erosion

Soils in the South Shore planning area have a low erodibility factor in their natural condition. Pasture and forest lands have little or no erosion problems at present, and it is expected that this situation will continue. Erosion of uplands will be a minor problem in this area; conservation land treatment is expected to be sufficient. Much of the erosion damages can be avoided through a sound urban-environmental forestry program to retain as much of the native vegetation as possible.

Coastal Flooding and Erosion

The South Shore coastline is vulnerable to coastal flooding and erosion from northeasters and hurricanes. Tidal flooding problems from hurricanes have been less than for other planning areas because the hurricanes have been parallel to the shore or a considerable distance offshore, thereby minimizing onshore wave action and tidal build-up. The arm of Cape Cod also protects this area from hurricane wave action.

Northeasters have caused the greatest tidal flood and wave damages in the planning area. In the winter of 1957-58, 18 storms occurred in the area and caused serious tidal flooding. Other severe storms occurred in December 1959, January 1961, November 1963, and February 1972. The Corps of Engineers has estimated that at least 15,000 acres are subject to tidal flooding (based on 100-year frequency storms.)

Damages from the December 1959 storm, although less severe than others, have been estimated by the Corps of En-

gineers: Plymouth ($20,000), Duxbury ($25,000), Marshfield ($110,000), Scituate ($290,000), or a total of an estimated $445,000. Following one severe northeaster in February 1972, emergency repairs were made by the Corps and the state totaling over $1.3 million along the Scituate shoreline, alone.

Coastal Erosion

Critical coastal erosion of three feet or more per year occurs along some 24,600 feet of shoreline per year, according to rough estimates by the Corps of Engineers. This erosion occurs primarily in Plymouth (11,600 feet), Duxbury (10,500 feet), Marshfield (1,500 feet), and Scituate (1,000).

Much of this erosion occurs along the beaches. The Corps of Engineers conducted a beach erosion control study of the South Shore in 1959 in cooperation with the Commonwealth of Massachusetts. Following that study, which recommended beach widening at North Scituate Beach, one project was adopted in 1962, and sandfill was completed in 1967. But subsequent erosion took place and in 1970 the Corps of Engineers completed a second North Scituate Beach Evaluation Study, which recommended further study to modify the project.

The Solutions

A number of options were considered for reducing flooding and erosion damages in both riverine and coastal portions of the planning area. These are more fully discussed in the *Regional Report, Chapter 8.*

Recommendations

A major result of the SENE Study has been the classification of the region's Critical Environmental Areas according to their capability. Inland and coastal wetlands, estuaries, beaches, barrier beaches, and critical coastal erosion areas have been classified as "A" resources, Priority Protection Areas, requiring the greatest degree of protection from development. Flood plains and hazardous coastal flooding areas (both to the 100-year flood frequency line) have been classified as "B" resources, Other Protection Areas, or management areas which have very limited tolerance for development, but with proper management are suitable for such compatible activities as agriculture or recreation.

In keeping with these resource classifications, the recommended actions are:

1. **Develop flood plain management programs which maximize non-structural solutions. Comprehensive flood plain management programs should be developed for riverine and coastal flooding areas. Such programs should make use of non-structural solutions wherever possible.**

All such programs should be developed in close cooperation between federal and state agencies, regional planning agencies, and local governments and interests. They should also be coordinated with related programs, such as the National Flood Insurance Program, the National Weather Service, state wetlands acts, land use planning programs, and for coastal areas, with the state coastal zone management program.

Section 73 of the Water Resources Development Act of 1974 authorizes federal cost sharing for non-structural measures. Although implementation of Section 73 has presently been deferred by the Office of Management and Budget (OMB), application of the cost sharing authority can be an important factor in making non-structural solutions more competitive than they have been. Thus, the ongoing Pilgrim Area Resource Conservation and Development project may be a useful source of funds for such non-structural technical and mapping assistance for flood prone areas, and even acquisition of certain areas.

An area particularly appropriate for development of a comprehensive flood plain management program includes the North and South Rivers watershed.

More specifically, localities should:

2. **Adopt local flood plain zoning preventing adverse flood plain development. Municipalities should adopt flood plain zoning to prevent adverse development in flood prone areas (and particularly in the 100-year floodway) as defined under the National Flood Insurance Program.**

Several towns in the planning area have established special flood plain districts designed to protect those critical areas from incompatible uses. The recommended action also includes incorporating inland and coastal wetlands, eroding areas, and storms of record on one map upon which the zoning is based.

Related to local zoning action are two recommendations for controlling local sedimentation and inland erosion problems.

3. **Establish local sediment and erosion control ordinances. Municipalities, assisted by the U. S. Department of Agriculture and the Executive Office of Environmental Affairs, should establish local sediment and erosion control ordinances.**

Models for such ordinances are included in the more detailed information prepared for the Study and available through NERBC.

4. **Establish forest buffer zones. Municipalities should establish appropriate forest buffer zones within 200 feet of streams and lakes to preserve vegetation and maintain natural systems through forestry techniques to help keep non-point source pollutants from reaching sensitive water quality areas.**

Towns with existing high and medium-high development pressure *(see Chapter 3, Guiding Growth)* should be among the first to implement these two recommendations.

5. **Establish local regulations to strengthen flood plain management. Municipalities should ensure that all regulations, including building and sanitary codes, reinforce the intent of the zoning districts and regulations recommended above.**

The regulations should also take advantage of the restrictive provisions of state wetlands regulation, scenic rivers programs, and the like. Technical assistance should be provided to all officials responsible for enforcing the zoning and related regulations.

In conjunction with a flood plain zoning program:

6. **Acquire significant flood plains and wetlands. Municipalities should investigate continuing possibilities to acquire those wetlands and flood plain areas most significant for flood damage reduction and protection, and which have water supply, wildlife, and/or recreation values.**

Particular emphasis should be given to protection of areas classified as unique natural areas and those located in areas subject to high and medium-high development pressure. Protection of wetlands and flood plains is also expected to help existing structural flood protection projects do their job by keeping flood flows to within the design capacity of the existing dams, channels, etc. More specific actions regarding wetlands protection are included in *Chapter 8 of the Regional Report.*

In built-up and heavily used areas, alternative locations outside the flood plain may not be feasible. Therefore,

7. **Locate in existing safe buildings in the flood plain. Where location outside the flood plain is not feasible, municipalities should encourage private interests to locate in existing safe buildings in the flood plain, rather than permitting new construction in the flood plain.**

Floodproofing, especially of existing buildings, is particularly appropriate where only moderate flooding is expected, where other types of flood protection are not feasible, or where activities on waterfront location need some degree of protection. Improved and expanded storm and flood forecasting and warning services, recommended in *Chapter 8 of the Regional Report,* will also be important in keeping down future damage costs.

The *Regional Report, Chapter 8,* recommended including critical coastal erosion areas in 100-year coastal flood prone areas, and putting this entire coastal flooding zone under the jurisdiction of the coastal zone management program.

On a local level, recommendation number 2 called for prohibiting development and other damaging uses of critical erosion areas through local flood plain zoning. In addition, municipalities should:

8. **Encourage natural stabilization of coastal erosion areas. Municipalities and conservation commissions should continue to encourage stabilization of coastal erosion areas, giving priority to areas eroding at a critical rate (3 feet or more per year).**

Use of vegetative cover, snow fences, discarded Christmas trees, and boardwalks have proven to be effective measures in controlling accelerating rates of wind and wave erosion. Such programs are now under way at Duxbury Beach and Long Beach (in Plymouth).

No specific sites have been recommended for structural erosion control projects in this planning area. However, *Chapter 8 of the Regional Report* recommends selective construction of erosion control projects for areas other than beaches such as eroding bluffs (except for unique natural sites). Artificial beach nourishment does not provide substantial benefits unless public recreational benefits are added in as well. Therefore, further discussion of the possibilities for beach nourishment are included in the *outdoor recreation chapter of this report.* Any studies and projects should address the littoral drift relationships between beach erosion and headland protection.

Implications

This approach is a good deal more restrictive than the National Flood Insurance Program requires. But it does make full recognition of resource limitations and

natural functions of wetland and flood plain areas. The SENE Study has found that all new development can be accommodated in C, F, and G lands (Developable Areas as discussed in *Chapter 3, Guiding Growth),* so that protecting A and B lands from inappropriate use need not be incompatible with a growing economy. In fact, a policy of resource protection and non-structural solutions is regarded as a significant step toward protecting the physical beauty of the region's landscape which is expected to be in the long-term interest of the SENE region.

CHAPTER 9 LOCATING KEY FACILITIES

One of the most difficult subjects to grapple with at the local level is the siting and operation of such *key facilities* as power plants and sand and gravel pits. Bluntly stated, they are unwelcome neighbors. At the same time, however, few people are willing to live with the consequences of not having enough of the vital products or services provided by these operations. The situation is further complicated by increasing competition from other potential users of the sites which are appropriate for sand and gravel mining and power plant siting.

These are issues of greater than local importance and are dealt with in detail in *Chapter 9 of the Regional Report.* However, sand and gravel extraction and power generation are significant issues on the South Shore, and warrant some special attention within the Planning Area Report.

SAND, GRAVEL, AND STONE MINING

Because no adequate statewide survey of potential sand and gravel deposits exists, the Study was unable to get an accurate picture of the supply situation on the South Shore. The U. S. Bureau of Mines, however, estimates that consumption of construction aggregate in the planning area in 1970 alone was 710,000 tons.

At present, processed sand and gravel are produced at three plants on the South Shore – two in Marshfield and one in Kingston. Granite is quarried and crushed in Quincy and Weymouth, and dimension granite is quarried in Weymouth and Hingham. While Quincy, Weymouth, and Hingham are not within the South Shore planning area, the products produced are, at least in part, consumed there.

The SENE Study's investigations on the nature and direction of growth in the region, discussed in *Chapter 3 of the Regional Report,* show the South Shore municipalities continuing the very rapid urbanization experienced in the last several years. That kind of growth will place very heavy demands on the area's sand and gravel resources. The irony, of course, is that the very development which makes the resource so valuable, preempts the use of potential sand and gravel deposit sites for extraction. Stated simply, sand and gravel deposits make good development sites.

The competition for land, coupled with the understandable antipathy of many communities to sand and gravel extraction operations, places some hard choices before the people of the planning area. Unless builders, and therefore consumers, are willing to pay the skyrocketing prices for imported sand and gravel, or can wait until the feasibility of offshore mining is established, the existing known sand and gravel deposits will have to be secured from preemption as resources vital to the continuing health of the area. The nature of the alternatives, or the lack of them, is described in detail in *Chapter 9 of the Regional Report.*

While the pressure for development in the South Shore is perhaps more intense than many other areas in the study region, the management recommendations made in Chapter 9 of the Regional Report will be sufficient to preserve and regulate extraction on the South Shore. The recommendations provide for the Massachusetts Department of Environmental Quality Engineering to set statewide operating standards with local land use approvals, provide a permit procedure for all extraction operations, and oversee site reclamation. Perhaps more importantly, the recommendations provide for a statewide survey of potential sand and gravel sites to present a basis for protection of the resource for future use. Through a carefully planned program of sequential use of mineral deposit sites, adequate sand and gravel can be provided at the least environmental and economic cost to residents of the planning area.

POWER GENERATION AND POWER PLANT SITING

While the share of power generation simply cannot be computed along the hydrologic boundaries of the planning areas being used in this Study, special mention should be made of Boston Electric's Pilgrim Nuclear Complex in Plymouth, in many ways an interesting indicator of current power generation issues.

The first Pilgrim nuclear unit was placed in commercial operation in December 1972, and by year's end was producing 664 megawatts. An application has been submitted by Boston Edison for permission to construct a second nuclear unit with a "name-plate" capacity of 1,180 megawatts. Consideration of a third unit with the same capacity has been suspended for several reasons. According to Boston Edison, the third unit was suspended because of significant decreases in the power needs of industrial and commercial consumers. According to others, the unavailability of investment capital was at least as important a consideration. Both factors: conservation effects and tight money,

have significantly altered the pattern and scheduling of new generation capacity. Increasing pressure from local and scientific sectors has also lobbied against new construction, pending review of operational safety procedures.

The geographical location of the South Shore communities, close to the Boston demand center, the availability of land distant from dense population concentrations, and the abundance of cooling water makes the South Shore a prime location for future generation capacity development. The New York Staff of the Federal Power Commission recommends consideration of post-1990 development of 2700 megawatts of additional nuclear capacity, but is not site specific.

The alternatives and recommendations on power in *Chapter 9 of the Regional Report* detail, more appropriately, the regional issues involved. NERBC is confident that these recommendations will apply in the South Shore case. Briefly, the recommendations lean heavily on the potential reduction in the power consumption rates obtainable through a variety of conservation measures, and outline a series of policy steps for handling future siting issues in the state.

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